Review of the Maui's dolphin Threat Management Plan

Consultation Paper

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Ministry for Primary Industries
Manatū Ahu Matua

Department of Conservation
Te Papa Atawhai

Review of the Maui's Dolphin Threat Management Plan

MPI and DOC joint Discussion Paper No: 2012/18

ISBN No: 978-0-478-40083-0 (online)
ISSN No: 2253-3907 (online)

September 2012

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Cover: *Maui's dolphins*, 2011. Photo: R.M. Hamner, Oregon State University Marine Mammal Institute.

Cover design: Publishing Team, Department of Conservation.

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1.0 Purpose

The purpose of this consultation paper is to support a review and update of the Maui's dolphin portion of the Hector's and Maui's dolphin Threat Management Plan (TMP). The previous TMP was undertaken five years ago in 2007. This review process aims to reassess management measures based on updated information on the Maui's dolphin population, the human-induced threats they are exposed to, and their vulnerability to those threats.

To provide context to the management measures proposed in this paper:

> 'Hector's dolphin(s)' refers to the South Island subspecies (*Cephalorhynchus hectori hectori*), while 'Maui's dolphin(s)' refers to the North Island subspecies (*Cephalorhynchus hectori maui*). 'Hector's and Maui's dolphins' refers to the species collectively (*Cephalorhynchus hectori*). 'Hector's and/or Maui's dolphins' refers to both subspecies, and is used where the identification of the subspecies cannot be confirmed. This approach is taken to avoid confusion and enable distinction between the North and South Island subspecies' and the species as a whole.

Section 6 from the Ministry for Primary Industries (MPI) and Section 7 from the Department of Conservation (DOC) outline initial views on some proposals to effectively manage fishing-related and non-fishing-related human-induced threats to Maui's dolphins, respectively. The views and recommendations outlined in the paper are preliminary and are provided as a basis for consultation with stakeholders.

DOC and MPI welcome written submissions on the proposals contained in this document. All written submissions must be received no later than 5pm on Monday 12 November 2012.

Written submissions should be sent directly to:

Maui's dolphin TMP
PO Box 5853
Wellington 6011

Or email:

MauiTMP@mpi.govt.nz (To comment on fishing-related options proposed by MPI)

MauiTMP@doc.govt.nz (To comment on non-fishing-related options proposed by DOC)

All submissions are subject to the Official Information Act and can be released, if requested, under the Act. If you have specific reasons for wanting to have your submission withheld, please set out your reasons in the submission. MPI and DOC will consider those reasons when making any assessment for the release of submissions if requested under the Official Information Act.

MPI and DOC will consider all submissions, and following an analysis of submissions final recommendations will be developed for each agency's respective Minister to consider.

2.0 Document Structure

This document is structured as follows:

Section 3: Overview
This section summarises the purpose of the Hector's and Maui's dolphin Threat Management Plan, why the Maui's portion is being reviewed, and a brief summary of the management options and tools that are discussed in the later chapters.

Section 4: Context
This section provides context on the biology of Hector's and Maui's dolphins, and the abundance, distribution and vulnerability of the Maui's dolphin population off the west coast of the North Island to human-induced mortality.

Section 5: Threats to Maui's dolphins
This section summarises the actual and potential human, and non-human, induced threats to the Maui's dolphin population on the west coast of the North Island.

Section 6: Ministry for Primary Industries' fishing-related management proposals
This section outlines the Ministry for Primary Industries proposals to manage fishing-related threats to the Maui's dolphin population.

Section 7: Department of Conservation non-fishing-related management proposals
This section outlines the Department of Conservation's proposals to protect Maui's dolphins by managing non-fishing-related threats to the population.

Section 8: Research, monitoring and collaboration
This section summarises current (2012/13) monitoring activities off the west coast of the North Island and outlines an annual planning process for determining future research and monitoring requirements. This section also discusses how the public (including tangata whenua, stakeholders, government agencies, ENGOs) can assist government in these areas to reduce human-induced threats to the Maui's dolphin population.

Sections 9 to 13: Appendices
This section provides additional information including maps, fisheries characterisation, economic impact assessments, and references.

3.0 Overview

3.1 WHAT IS THE HECTOR'S AND MAUI'S DOLPHIN THREAT MANAGEMENT PLAN (TMP)?

Hector's and Maui's dolphins are endemic to New Zealand and are considered to be one of the world's rarest dolphin species. They were gazetted in 1999 as a threatened species under the Marine Mammals Protection Act 1978. Maui's dolphins are listed as Nationally Critical under the New Zealand Threat Classification System, and Critically Endangered under the International Union for the Conservation of Nature Red List Categories and Criteria.

The government's Vision Statement[1] for the management of Hector's and Maui's dolphins includes:

> *"Hector's and Maui's dolphins should be managed for their long-term viability and recovery throughout their natural range."*

As part of a long-term strategy to achieve this vision, and public and government concern over the effect of human-induced mortality on these dolphins, the Hector's and Maui's dolphin Threat Management Plan (TMP) was developed in 2008[2]. The Hector's and Maui's TMP is led by the Department of Conservation (DOC) and the Ministry for Primary Industries (MPI). The TMP is not a statutory document; rather it is management plan that identifies human-induced threats to Hector's and Maui's dolphin populations and outline strategies to mitigate those threats.

The goals of the Hector's and Maui's dolphin TMP are to:

- ensure that the long-term viability of Hector's and Maui's dolphins is not threatened by human activities; and
- further reduce impacts of human activities as far as possible, taking into account advances in technology and knowledge, and financial, social and cultural implications.

3.2 WHY ARE WE REVIEWING THE MAUI'S DOLPHIN PORTION OF THE TMP?

The Hector's and Maui's dolphin TMP is designed to:

- describe the nature and extent of threats to Hectors and Maui's dolphins; and
- put in place strategies to reduce those threats which are human-induced.

On 13 March 2012, in light of new information, the Minister for Primary Industries and the Minister of Conservation announced that the review of the Maui's dolphin portion of the TMP would be brought forward from 2013 and undertaken in 2012.

The review of the Maui's portion of the TMP will reconsider the management strategies and/or research that will support the recovery of the Maui's dolphin population. In considering how to deliver on the TMP goals for the Maui's portion the Minister for Primary Industries and Minister of Conservation each must consider and meet their legislative obligations. The relevant statutory considerations for the Minister for Primary Industries are described in Section 6, and for the Minister of Conservation in Section 7 of this document.

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[1] The Vision Statement is derived from the DOC's Conservation General Policy.
[2] The previous Ministry of Fisheries and DOC: http://www.fish.govt.nz

3.2.1 New information available

3.2.1.1 Maui's dolphin mortalities

On 2 January 2012, a Hector's or Maui's dolphin died in a commercial set net off Cape Egmont, Taranaki ('the January mortality')[3]. The mortality was reported by the fisher to be a Hector's dolphin but the dolphin was not retained to confirm subspecies identity. It is however, not possible to visually distinguish between Hector's and Maui's dolphins. This mortality occurred outside of the area subject to fishing-related closures put in place during the 2008 TMP review.

On 26 April 2012, an unrelated dolphin stranding (cause of death was found to be natural) was discovered south of where the January mortality occurred (Kina Road Beach, near Opunake, Taranaki). DNA testing on this dolphin found it to be a Hector's dolphin.

Given the DNA findings from the Opunake stranding in April, the likely subspecies identity (a Hector's or Maui's dolphin) of the January mortality is equivocal.

3.1.1.2 Maui's dolphin abundance estimate

A new estimate of the population abundance of Maui's dolphins has been released by DOC[4]. The abundance of Maui's dolphins' over 1 year of age is estimated to be 55 (with a 95 percent confidence that the number of dolphins over 1 year old is between 48 and 69).

An updated Potential Biological Removal (PBR) estimate was commissioned by DOC based on the new population abundance estimate[5]. The PBR analysis estimates the maximum number of dolphins, not including natural mortalities, which may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population size with high probability[6].

The updated PBR analysis estimates the Maui's dolphin population can sustain one human-induced mortality every 10 to 23 years without impacting on its ability to rebuild to its optimum sustainable population size.

3.2.2 Risk assessment report

To support the review of the TMP, a risk assessment workshop was held in June 2012 with the purpose of identifying, analysing and evaluating all threats to Maui's dolphins found off the west coast of the North Island (WCNI)[7]. All new information on Maui's dolphin biology and potential threats was evaluated and incorporated in the risk assessment workshop process, and was used to estimate the level of impact and corresponding risk posed by these threats, individually and collectively. The risk assessment scoring was conducted by an expert panel of domestic and international specialists in marine mammal science and ecological risk assessment. The method for the risk assessment involved five key steps: defining Maui's dolphin distribution, threat identification, threat characterisation including the spatial distribution of the threat, threat scoring, and subsequent analysis.

The outcome of the panel's threat scoring was used to assess the cumulative impact and associated population risk posed by all threats combined (and also disaggregated the impacts

[3] Reported by-capture of a Hector's or Maui's dolphin off Taranaki: Nov 2011-Jan 2012 Incident Update.
[4] Hamner et al (2012): http://www.doc.govt.nz/mauis-dolphin-abundance-estimate-report.pdf
[5] Wade et al Appendix 1 in Currey et al (2012).
[6] Wade (1998).
[7] Currey et al (2012).

of the respective threats) to identify those threats that pose the greatest risk to the Maui's dolphin. It also identified several threats that may have a low likelihood, but which, given the small population size of Maui's dolphins, may have detrimental consequences for the population. Further information on the risk assessment outcomes is discussed in Section 5.

3.3 SUMMARY OF MANAGEMENT OPTIONS AND OTHER TOOLS

A range of management options has been developed for consideration to manage the effects of human-induced mortality on Maui's dolphins. It is acknowledged, that:

- The nature and extent of human-induced threats to Maui's dolphins is still highly uncertain, due to gaps in available information.
- Through the Marine Mammals Protection Act 1978, and a range of other legislative instruments and policies (outlined in Section 7), the Minister of Conservation can consider and seek to put in place measures that may be necessary to manage species recovery to a viable population size throughout its natural range.
- The Minister for Primary Industries may, after consultation with the Minister of Conservation, take such measures he or she considers are necessary to avoid, remedy, or mitigate the effects of fishing-related mortality on any protected species.
- A precautionary approach is available to the Minister for Primary Industries when considering the extent to which utilisation threatens the sustainability of a protected species population[8].

MPI and DOC consider a combination of the tools available under the Fisheries Act 1996 and the Marine Mammals Protection Act 1978 will allow an integrated approach to the management of human-induced threats to the Maui's dolphin population. MPI and DOC consider an integrated approach is the best way to meet the goals of the review of the Maui's portion of the TMP.

A similar approach has been adopted in the past through the Hector's and Maui's TMP where both Acts were utilised to address and manage the fisheries-related and non-fishing-related risks, by MPI and DOC, respectively. It is recognised that MPI is better placed in terms of resourcing (primarily through fisheries officers and observers) to actively enforce and monitor any fishing restrictions. MPI control of fishing restrictions also removes regulatory duplication and any on the water confusion as to who enforces such restrictions. Although fishing restrictions could be put in place within a Marine Mammal Sanctuary under the Marine Mammals Protection Act 1978, for the purposes of the TMP it has been agreed by Ministers that fishing restrictions will be considered under the Fisheries Act 1996, which has stronger penalties and more capability for enforcement.

[8] The Court of Appeal (*Squid Fishery Management Co* v *Minister of Fisheries* (13 July 2004, CA39/04, para 79) has recognised that a precautionary approach is available to the Minister. The context of this case was the impact of squid fishing on the New Zealand sea lion population. This approach was followed by Mallon J in the High Court in 2009 when considering measures put in place to protect Hector's and Maui's dolphins (*New Zealand Federation of Commercial Fishermen Inc et al* v *Minister of Fisheries and Chief Executive of Ministry of Fisheries* High Court, Wellington, 23 February 2010, CIV 2008-485-2016, para 19).

3.3.1 Fishing-related threat management options

Scientific and anecdotal information indicates fishing is the greatest known human-induced impact on Maui's dolphins. The risk of fishing-related mortality on Maui's dolphins is dependent on the degree to which fishing activity and Maui's dolphin distribution overlap. To address these risks a range of options to reduce the risk of fishing-related mortality for the Maui's dolphin population are considered, summarised below and explained in more detail in Section 6. For context on any place names referenced in the body of this paper, refer to Map 1 in Appendix 1.

Commercial and Amateur Set Netting (Coastal)	
Option 1	*Status quo*: Keep existing management, including the interim measures to: • retain the set net ban between 0 and 2 nautical miles offshore from Pariokariwa Point to Hawera; • prohibit the use of commercial set nets between 2 and 7 nautical miles offshore from Pariokariwa Point to Hawera without an observer onboard, and; • pay for observer services costs with Crown-funding. The interim measures would be reviewed in 2015 to inform management going forward.
Option 2	Keep existing management, and put the interim measures in place via regulation to: • retain the set net ban between 0 and 2 nautical miles offshore from Pariokariwa Point to Hawera; • prohibit the use of commercial set nets between 2 and 7 nautical miles offshore from Pariokariwa Point to Hawera without an observer onboard, and; • require observer services costs to be cost-recovered from industry beginning 1 October 2013.
Option 3	• Extend the set net ban between 0 and 4 nautical miles offshore from Pariokariwa Point to Hawera. • Prohibit the use of commercial set nets between 4 and 7 nautical miles offshore from Pariokariwa Point to Hawera without an observer onboard.

Commercial and Amateur Set Netting (Harbours)	
Option 1	*Status quo*: Keep existing management.
Option 2	Improve information on Maui's dolphin distribution and set net activity in the west coast North Island harbours, with a focus in the Manukau Harbour.
Option 3	• Extend the existing set net ban in the entrance of the Manukau Harbour further into the harbour. • Improve information on Maui's dolphin distribution and set net activity in the west coast North Island harbours, with a focus in the Manukau Harbour.

Commercial Trawling	
Option 1	*Status quo*: Keep existing management.
Option 2	Put in place extensive monitoring coverage in the commercial trawl fishery between 2 and 7 nautical miles offshore from Maunganui Bluff to Pariokariwa Point.
Option 3	• Extend the trawl ban from 2 and 4 nautical miles offshore from Kaipara Harbour to Kawhia Harbour. • Put in place extensive monitoring coverage in the commercial trawl fishery between 2 and 7 nautical miles offshore from Maunganui Bluff to Pariokariwa Point.

MPI also discusses additional sustainability measures that may support reducing the risk of fishing-related mortality on the Maui's dolphin population. These additional measures would be considered in conjunction with the broader options discussed above where they may further mitigate the potential fishing-related impacts on dolphins while allowing for the use of fisheries resources. The options discussed include:

(1) Fishing gear exemptions:
  - Exclude some fishing methods from the set net prohibitions if they are likely to avoid, remedy or mitigate any adverse effects of fishing on the Maui's dolphin population.
  - For example, exclude the activity of ring netting from the set net prohibitions in the Manukau Harbour, and other WCNI harbours.

(2) Finer spatial-scale reporting requirements for commercial set net fishers:
  - Improve information on the distribution and intensity of fishing effort in areas of potential overlap with Maui's dolphin distribution.
  - For example, require commercial set net fishers to report the start and end position of each set net they deploy.

(3) Changes to fishing behaviour practices:
  - Consider changes to fishing behaviour or practices that are likely to avoid, remedy or mitigate any adverse effects of fishing on the Maui's dolphin population.
  - For example:
    - reduce the total length and/or number of set nets that can be deployed at any one time,
    - introduce seasonal closures in the commercial and amateur set net fishery, and/or
    - introduce maximum headline heights for trawl nets.

Section 6 of this document provides more detail of each of these options.

3.3.2 Non-fishing-related threat management options

While fishing-related threats are the greatest known human-induced impact on Maui's dolphins, they are not the only potential source of impact. The risk assessment workshop held in June 2012 suggested that each of the non-fishing-related human-induced threat had between 30% and 60% likelihood of exceeding the PBR, even in the absence of all other threats[9]. To reduce the risk to Maui's dolphins from these threats a range of options are proposed, summarised below and explained in more detail in Section 7.

West Coast North Island (WCNI) Marine Mammal Sanctuary (MMS) Variation		
MMS Option 1	*Status quo*	No MMS variation
MMS Option 2	MMS extension	Extension of the WCNI MMS south to Hawera and offshore to 12 nautical miles

Options to reduce risk to Maui's dolphins from Seismic Surveying (SS), *option can be implemented in conjunction with any of the other options. See also Figure 7.1.		
SS Option 1	*Status quo*	Reliance on the Code of Conduct for seismic survey operations (the Code) and the existing MMS regulations.
SS Option 2a	Current Sanctuary + seismic restrictions consistent with Code	Maintaining the current sanctuary boundaries plus variation of the legal restrictions on seismic surveying within the MMS to be consistent with the Code.
SS Option 2b	Current Sanctuary + Seismic prohibition	Maintaining the current sanctuary boundaries plus a prohibition on seismic surveying operations within the MMS.
SS Option 3a	Extension of MMS + extension of seismic restrictions	Extend the MMS south to Hawera and offshore 12 nm plus extending the existing legal restrictions on seismic surveying operations within the MMS.
SS Option 3b	Extension of MMS + seismic restrictions consistent with Code	Extend the MMS south to Hawera and offshore 12 nm plus a variation of the legal restrictions on seismic surveying within the MMS to be consistent with the Code.
SS Option 3c	Extension of MMS + Seismic prohibition	Extend the MMS south to Hawera and offshore 12 nm plus a prohibition on seismic surveying operations within the MMS.
SS Option 4	Stand-along Regulations	Develop stand-alone regulations under the Marine Mammals Protection Act to regulate seismic operations.
SS Option 5 (additional)*	Prohibit petroleum mining	Prohibition of petroleum mining throughout the MMS. This option could be implemented in addition to one of the options 1 to 4 above.

[9] Currey et al (2012).

Options to reduce risk to Maui's dolphins from Seabed Mineral Exploitation (SME), *option can be implemented in conjunction with any of the other options. See also Figure 7.2.		
SME Option 1	*Status quo*	No change in MMS Restrictions in specified areas (4 nm core distribution area; 2 nm elsewhere).
SME Option 2a	Current Sanctuary + offshore limit 4 nautical miles	Maintain the current sanctuary boundaries plus extending the current mining restrictions to 4 nm offshore within the entire sanctuary.
SME Option 2a	Current Sanctuary + offshore limit 7 nautical miles	Maintain the current sanctuary boundaries plus extending the current mining restrictions to 7 nm offshore within the entire sanctuary.
SME Option 2c	Current Sanctuary + depth contour offshore limit	Maintain the current sanctuary boundaries plus extending the current mining restrictions to a suitable depth contour along the length of the entire sanctuary.
SME Option 3a	Extension of MMS + extension of mining restrictions to 2nm offshore	Extend the MMS south to Hawera and offshore to 12 nm plus extending the current mining restrictions to 2 nm offshore throughout the extension.
SME Option 3b	Extension of MMS + extension of mining restrictions to 4nm offshore	Extend the MMS south to Hawera and offshore to 12 nm plus extending the current mining restrictions to 4 nm offshore within the entire sanctuary.
SME Option 3c	Extension of MMS + extension of mining restrictions to 7 nautical miles offshore	Extend the MMS south to Hawera and offshore to 12 nm plus extending the current mining restrictions to 7 nm offshore within the entire sanctuary.
SME Option 3d	Extension of MMS + extension of mining restrictions to depth contour	Extend the MMS south to Hawera and offshore to 12 nm plus extending the current mining restrictions to a suitable depth contour along the length of the entire sanctuary.
SME Option 4 (additional)*	Moratorium on active mining	Moratorium on the active seabed mineral mining phase within the MMS, for the 5 year duration of the TMP. This option could be implemented in addition to one of the options 1 to 3 above.
SME Option 5	Code of Conduct	Develop a Code of Conduct for seabed minerals exploitation similar to that for seismic surveying.

Options to reduce risk to Maui's dolphins from Commercial Marine Mammal Tourism (CT), *option can be implemented in conjunction with any of the other options		
CT Option 1	*Status quo*	No regulatory change.
CT Option 2	Moratorium under the MMPR	A moratorium on commercial marine mammal tourism permits under the Marine Mammals Protection Regulations (MMPR) targeting Maui's dolphins.
CT Option 3	Restrictions within MMS	• No commercial tourism targeting Maui's dolphins. • No swimming with Maui's dolphins. • 10 minute time limit for opportunistic viewing for recreational boats, in addition to observing MMPR 18 to 20.
CT Option 4 (additional)*	Increased engagement and compliance	Increase education on MMPR 18 to 20; increase compliance and monitoring of marine mammal tourism in Maui's dolphins range.

Options to reduce risk to Maui's dolphins from Commercial Shipping (CS)		
CS Option 1	*Status quo*	No additional measures for commercial shipping.
CS Option 2	PSSA	Submission to International Maritime Organisation seeking Particularly Sensitive Sea Area (PSSA) designation, with measures such as heightened navigational controls or prohibition of all discharges.
CS Option 3	ATBA	Submission to International Maritime Organisation seeking Area to Be Avoided (ATBA) designation.

Options to reduce risk to Maui's dolphins from Marine Spills (Oil & Harmful Substance) (MS). A range of options could be implemented together.		
MS Option 1	*Status quo*	No additional action taken.
MS Option 2	Actively monitored zone	Using Automatic Identification System (AIS) technology for vessel related compliance purposes and to reduce risk of accidents that could cause oil and other spills in Maui's dolphins range.
MS Option 3	DOC involvement with OPAC	Active involvement in the Oil Pollution Advisory Committee (OPAC) to ensure that response planning includes consideration of Maui's dolphins.
MS Option 4	DOC involvement with OWR	Increased involvement with Massey University Oiled Wildlife Response (OWR) Team to ensure increased collaboration in responses and identification of research gaps, with respect to Maui's dolphins.

Options to reduce risk to Maui's dolphins from Land-based Activities and Coastal Development (CD). A range of options could be implemented together.		
CD Option 1	Maui's dolphins considered in resource consent applications	Advocating for Maui's/Hector's dolphin protection when consulted on any relevant resource consent applications.
CD Option 2	Engagement with Territorial Authorities and Regional Councils	Engaging with Territorial Authorities and Regional Councils during planning processes and reviews of plans to ensure adequate regard is given throughout known and potential Maui's dolphin range.
CD Option 3	NZCPS and CMS revision	Amending provisions in the New Zealand Coastal Policy Statement (NZCPS) and Conservation Management Strategies (CMS)s which direct councils to identify and protect Maui's dolphin habitat.
CD Option 4	Awareness in RMA process	Ensuring that teams responsible for Resource Management Act (RMA) consent processing are aware of the potential impacts of proposed activities on Maui's dolphins.
CD Option 5	Liaison regarding pollution	Identify sources of pollution that could threaten Maui's dolphins and promote appropriate controls to the administering bodies.

Options to reduce risk to Maui's dolphins from Thundercat Racing (TR). A range of options could be implemented together.	
TR Option 1	'Soft-start' concept similar to seismic surveying, gradually building up noise levels prior to the start of races to give dolphins the opportunity to leave the area.
TR Option 2	Specified practice areas/times.
TR Option 3	Posting of observers to look out for Maui's dolphins.
TR Option 4	Aerial observation of areas prior to race start to ensure no dolphins are in the area.

Options to reduce risk to Maui's dolphins from Surf Life Saving events (SLS). Both options could be implemented together.	
SLS Option 1	Ongoing engagement with Surf Life Saving clubs looking at educational options.
SLS Option 2	Utilising observers during competitions and/or training events to look out for Maui's dolphins.

Options to reduce risk to Maui's dolphins from Recreational boating (RB). A range of options could be implemented together.	
RB Option 1	Promotion and enforcement of the Marine Mammals Protection Regulations.
RB Option 2	Development of appropriate advocacy tools to support community engagement work.
RB Option 3	Targeted advocacy over summer months when recreational boaters are most active.
RB Option 4	Working with Maritime New Zealand and other boating interest groups (such as Coastguard, regional safe-boat forums, harbourmaster interest groups and boat shows) to effectively engage the target audience.

Options to reduce risk to Maui's dolphins from Scientific Research (SR). A range of options could be implemented together.	
SR Option 1	Regular engagement and training with scientists and DOC staff regarding best practice techniques for use on Hector's and Maui's dolphins.
SR Option 2	Ensuring anyone undertaking research is appropriately qualified.
SR Option 3	Strict adherence to current legislation and standard operating procedures.
SR Option 4	Developing stricter risk assessment protocols regarding permit processing.
SR Option 5	Research undertaken is guided by research priorities and a researching planning process (Section 8.1 for more details of options regarding research planning).
SR Option 6	Any research granted a permit has to be able to demonstrate clear benefits for the population and the gains MUST outweigh the risk.

Options to reduce risk to Maui's dolphins from Disease (D). A range of options could be implemented together.	
D Option 1	Ongoing necropsy of Maui's dolphins found beachcast to determine incidence of disease, including *Toxoplasma gondii*.
D Option 2	Research to understand the origin of *Toxoplasma gondii*, the impacts of it on the population, and whether there are ways to mitigate against it (see research, Section 8.2.1.2, for further details).
D Option 3	Engagement with stakeholder groups to raise awareness and encouraging safe practices to minimise the occurrence of *Toxoplasma gondii* getting into waterways and the sea.

3.4 RESEARCH, MONITORING, AND COLLABORATION

3.4.1 Research

MPI and DOC propose to develop an annual planning and review process to provide a more systematic procedure for determining future research and monitoring requirements to support management of the Maui's dolphin.

The annual planning and review process would:

- Develop an ongoing review framework for an overarching strategy for research, monitoring and collaboration.
- Review the current management questions of both DOC and MPI to identify and prioritise the key information needs to aid future management decisions.
- Develop an adequate programme for monitoring the population and compliance of any mitigation measures, noting that due to small population size of the Maui's dolphin it will be difficult to reliably assess the effectiveness of current management measures.
- Outline approaches to address the information needs to assist DOC and MPI in developing research proposals or monitoring programmes for the following year(s).
- Review the performance (that is quality, deliverables, and targets) of any research projects and monitoring programmes that were undertaken and/or completed in the current year.

3.4.2 Monitoring

MPI proposes to continue 100 percent observer coverage in the set net fishery off the Taranaki coast between Pariokariwa Point and Hawera, as well as work with industry to develop an extensive monitoring programme in the WCNI trawl fishery.

MPI will also continue to work on compliance, and act on information from the public to determine where compliance with both mandatory and voluntary mitigation measures need to be improved.

DOC proposes to use a combination of boat and aerial surveys, community engagement programme and commercial fisher liaison programme to continue to improve information on Maui's dolphin distribution off the WCNI.

MPI and DOC propose the annual planning and review process for research also be used as a tool to develop effective and targeted monitoring programmes where information is most required.

3.4.3 Collaboration

3.4.3.1 Iwi Partnerships

MPI and DOC recognise their statutory and regulatory obligations to Māori and the important contribution made by tangata whenua to fisheries and non-fisheries management, and the wider environment.

The Fisheries Act 1996 provides for input and participation, consultation and regard to Kaitiakitanga. Section 4 of the Conservation Act 1987 recognises the obligations of the Crown to Māori as Treaty of Waitangi partners, providing the basis for government (among other objectives) to enable whānau, hapū and iwi to fulfil their kaitiakitanga responsibilities towards Maui’s dolphin, as one part of a broader responsibility for protecting the health of the marine environment.

MPI and DOC are seeking input from tangata whenua into the development, review and implementation of the TMP and encourage participation by whānau, hapū and iwi into the active protection of Maui's dolphins.

3.4.3.2 Other stakeholders

Furthermore, DOC and MPI consider the review of the TMP as providing a platform for all stakeholders to engage and take action to reduce threats to Maui’s dolphins. To support this discussion DOC and MPI have listed some suggestions for various groups that share an interest in protecting this unique subspecies. Collaborative projects or initiatives may be possible where these groups have a shared interest in a region or on a particular activity. For example, there is uncertainty about Maui’s dolphin distribution and use of the WCNI harbours, but the harbours and catchments are areas of intensive use in which tangata whenua and various stakeholder bodies have an interest.

Suggestions for collaboration include:

- Report sightings and strandings of dolphins.
- Review the named research priorities, comment on their suitability and undertake or support projects where possible.
- Provide input into the research planning process.
- Help develop better tools for reporting sightings or raising public awareness.
- Seek opportunities to collaborate with others, government, industry, community groups, whānau, hapū and iwi to increase the capacity of research.

3.5 IMPLEMENTATION

The updated Maui’s portion of the Hector’s and Maui’s dolphin TMP will outline the management framework for managing human-induced threats to Maui’s dolphins. The plan will outline: the biological characteristics, the vulnerability of the species to human-induced threats and provide a characterisation of those threats, the management measures in place to reduce the risk of human-induced mortality, and research and monitoring sections that provide both a framework for gathering and reviewing new information to update the plan.

The Minister for Primary Industries will consider all submissions and best available information on fishing-related-threats and the Minister of Conservation will consider all submissions and best available information on non-fishing-related threats. The Ministry for Primary Industries will, after consultation with the Minister of Conservation, decide on what management measures will be put in place to address fishing-related threats. The Minister of Conservation will decide what management measures will be put in place to address non-fishing-related threats.

The Minister for Primary Industries and Minister of Conservation can choose different management measures for each type of fishing or non-fishing-related threat, respectively, and could also choose to bring in measures immediately or over time. The Minister for Primary Industries decision(s) to address fishing-related threats will be based on the level of risk they consider appropriate for the Maui’s dolphin population as a whole. Likewise for the Minister of Conservation who will choose management measures to address non-fishing-related threats.

Increased levels of monitoring (for example, observer coverage and/or electronic monitoring on fishing vessels) and research will be recommended to analyse the effectiveness of any management measures.

The resulting TMP for Maui's dolphins will contain those management measures agreed to by Ministers and will be available in 2013. The TMP will be of five years' duration and aspects such as the research and monitoring programmes will be subject to ongoing, annual review. As new information comes to light, the TMP may be modified at any stage to better reflect current understanding.

4.0 Context

This chapter provides a detailed summary of the biology of Maui's dolphins including information on its distribution off the west coast North Island. Its purpose is to summarise the latest scientific information that informs the fisheries-related management measures proposed in Section 6, and non-fishing-related management measures proposed in Section 7.

4.1 NEW ZEALAND'S MAUI'S DOLPHINS

4.1.1 Taxonomic status

Hector's and Maui's dolphins are endemic to New Zealand, meaning they are only found in New Zealand's waters. The species, *Cephalorhynchus hectori*, is divided into two subspecies (based on genetic and skeletal differences):

- *Cephalorhynchus hectori hectori* – Hector's dolphin, which occurs principally in South Island waters and occasionally off the west coast of the North Island, and
- *Cephalorhynchus hectori maui* – Maui's dolphin, which occurs in the waters off the north west coast of the North Island (WCNI). Map 1 in Appendix 1 shows the area referred to in this document as WCNI.

Maui's dolphins have been classified as distinct from the Hector's dolphin subspecies since 2002[10]. Prior to this time they were considered to be a geographically separate population of Hector's dolphins.

4.1.2 Physical description

Hector's dolphins and Maui's dolphins are not visually distinct and can only be differentiated through genetic testing or skeletal analysis. Hector's and Maui's dolphins are easily identified by their colouring (a combination of grey shading, creamy white and black), and a rounded ('Mickey Mouse' ear shaped) black dorsal fin[11]. The flippers have rounded tips and the body of the dolphin is stocky and well built.

4.1.3 Reproduction

Hector's and Maui's dolphins are short-lived with a maximum reported age of 22 years[12]. They also show a late onset of maturity. Females first give birth at age 7-9 years, while males tend to reach sexual maturity at age 6-9. Hector's and Maui's dolphins are slow breeders; females give birth to one calf every two to three years, although calving-intervals of between three to six years may occur[13].

4.1.4 Diet

Hector's and Maui's dolphins appear to feed mostly in small groups. The dolphins feed opportunistically, both at the bottom and throughout the water column and take a variety of species[14]. Surface schooling fish (for example, yellow-eyed mullet, kahawai) are eaten along with benthic fishes such as ahuru and red cod[15].

4.1.5 Social structure and behaviour

Maui's dolphins are generally found in small groups of four to five individuals, although

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[10] Baker et al (2002); Pichler (2002); Hamner (2008)
[11] Jefferson et al (2008)
[12] Rayment et al (2009a)
[13] Slooten (1991); Bräger (1998)
[14] Slooten and Dawson (1988)
[15] Miller et al (2012)

larger aggregations (≥ 8 dolphins) are occasionally seen[16]. Group size of Hector's and Maui's dolphins appears to be smaller on average in winter than in summer[17]. While Hector's and Maui's dolphins form relatively closed groups of animals, within these groups of individuals both males and females tend to associate loosely with a relatively large number of other individuals within each group[18].

4.1.6 Abundance of Maui's dolphins

Key Points

- Abundance of Maui's dolphins greater than 1 year of age is estimated at 55 (with a 95 percent confidence that the number of dolphins over 1 year old is between 48 and 69).
- The most recent abundance estimate is lower than the previous abundance estimate from 2004 of 111 individuals (with a 95 percent confidence that the population is between 48 and 252 individuals). However, the methods used in the two studies are not directly comparable.

The most recent abundance estimate of population size for the Maui's dolphin is 55 individuals over 1 year of age (with a 95 percent confidence that the number of dolphins over 1 year old is between 48 and 69)[19]. Other surveys that have estimated Maui's dolphin abundance occurred in 1985, 1998, 2001-02, and 2004 (Table 4.1).

Table 4.1. Estimates of abundance (N) and associated 95% confidence limits (CL) for Maui's dolphins based on small-boat surveys, aerial sighting surveys, and genotype capture-recapture (GCR) [20]. (Source: Wade et al in Appendix 1 in Currey et al (2012))

Reference	Survey source	Applicable year(s)	N	Lower CL	Upper CL
Dawson and Slooten (1988)	Small boat strip transect	1985	134	n.a.	n.a
Martien *et al.* (1999)	Small boat strip transect	1985[21]	140	46	280
Russell (1999)	Small boat	1998	80	n.a.	n.a.
Ferreira and Roberts (2003)	Aerial line transect	2001/02	75	48	130
Baker *et al.* (2012)	Small boat GCR	2002[22]	69	52	100
Slooten *et al.* (2006)	Aerial line transect	2004	111	48	252
Hamner *et al.* (2012)	Small boat GCR	2010/11[23]	55	48	69

There were no systematic surveys to estimate Maui's dolphin abundance prior to 1984-85. The 2012 population estimate for Maui's dolphins is lower than the 2004 estimate, but the methods used in the two studies are not directly comparable because of differences in the methods used.

[16] Oremus et al (2012)
[17] Rayment et al (2006)
[18] Bräger (1999); Slooten et al (1993)
[19] Hamner et al (2012): Abundance estimate was calculated using genetic mark recapture analysis.
[20] Genotype capture-recapture (GCR) is a method for assessing population status through repeated genetic sampling and identification of individuals and statistical analysis of individual sighting records.
[21] Note: The estimate and confidence intervals in Martien et al (1999) were recalculated from the sightings reported in Dawson and Slooten (1988); ie, these are not independently derived.
[22] Note: Calculated here with a two-sample, closed-population model using genotype capture-recapture from samples collected in the years 2001 and 2003, as reported in Baker et al (2012).
[23] Note: The estimate and confidence intervals do not include two individuals identified as migrant Hector's dolphins, based on genotype population assignment.

DOC and MPI acknowledge there is uncertainty associated with Maui's dolphin abundance estimates (as shown by the wide confidence limits for each abundance estimate). However, all Maui's dolphin abundance estimates signal that the population is very small[24].

4.1.7 Population trends of Maui's dolphins

Key Points

- Most recent research estimates the Maui's dolphin population to be declining at 3 percent per year (with a probability of decline of 75.3 percent).
- Previous and most recent research findings are consistent with Maui's dolphins having a small population that is likely declining.

There are no comparative abundance estimates to show population trends of Maui's dolphins over time. However, population modelling and genetic analyses do show that Maui's dolphin abundance has declined. It is important to note the ability to detect a decline in population size becomes increasingly difficult as population size decreases.

A series of population models estimated Maui's dolphin abundance off the WCNI between the 1970s to mid 1980s[25]. Results approximated that between 1970 and 1985 the abundance of Maui's dolphins in some parts of the WCNI (indicated by fishing statistical reporting areas) had reduced by 3 - 10 times. The models were based on back-calculations using an estimated set net entanglement rate, and data on bycatch from fishing effort and abundance estimates from 1985[26]. Therefore, the method used is subject to wide confidence limits because of the difficulty in estimating both historical and current fishing-related mortality rates.

Although the population modelling estimates have a high level of uncertainty they corroborate trends observed in Maui's dolphin abundance in later genetic analyses. [27] Genetic analyses have used two approaches to infer trends in Maui's dolphin population abundance:

1. Examination of the recent and historical estimates of genetic diversity in the population over time found:
   - Low genetic diversity in the Maui's dolphin population, indicated local group differences or loss of diversity due to local group decline.
   - The Tajima D statistic, a conservative measure of recent population bottlenecks[28], also supported the suggestion of a recent decline in this population[29].

2. Population modelling (of individuals over 1 year old) based on genetic mark recapture analyses[30], which estimated a(n):
   - annual survival rate of the population at 84 percent (with a 95 percent confidence that the annual survival rate is between 75 and 90 percent), and;
   - population decline of -3 percent per year (with a 95 percent confidence that the population change is between a -11 percent decline to +6 percent increase per year)

[24] Regardless of method used to calculate abundance.
[25] Note: Parameters in the modelling work typically include estimates of dolphin productivity, current abundance, and estimates of fishing-related mortality.
[26] Burkhart and Slooten (2003)
[27] Pichler and Baker (2000); Pichler (2002); Hamner et al (2012): All detected a decline in the genetic diversity of the Maui's dolphin population that is more consistent with a recent decline in abundance than with other factors like sex bias or loss of populations. DNA from museum specimens and living dolphins indicates the population has lost two thirds of the maternal lineage of its mitochondrial DNA.
[28] Tajima D statistic is a method for detecting evidence that a population has undergone a population bottleneck, or a rapid reduction in abundance that can result in reduced genetic diversity.
[29] Pichler (2002)
[30] Hamner et al (2012)

        - with a 75.3 percent probability that the Maui’s dolphin population is declining[31].
    - The 2012 estimate is consistent with Maui’s dolphins having a small population, and suggest a decline in population size over the last decade.

4.1.8 Distribution of Maui’s dolphins off the WCNI as confirmed from DNA samples

Maui’s dolphins are visually identical to Hector’s dolphins. Sightings of Hector’s and/or Maui’s dolphins supported by collection of samples for genetic analyses allow the subspecies identity of the dolphin(s) observed to be verified. The distribution of Maui’s dolphins based on DNA analysis is discussed in this section. DNA samples cannot always be collected from sightings. Section 4.1.9 discusses the distribution of Hector’s and/or Maui’s dolphins from all sightings and strandings records in this area, which can be used to infer distribution of the Maui’s dolphin population.

The presence of Maui’s dolphins (and Hector’s dolphins that may travel up from parts of the South Island) off the WCNI has been confirmed[32] by genetic analyses (Table 4.2). This information has been used to develop a series of maps that display the location of sightings and strandings where Maui’s dolphins have been confirmed (Maps 2 and 3, Appendix 1). More than 95 percent of the 91 Maui’s and Hector’s dolphins that have been genetically sampled off the WCNI between 2001 and 2012 were Maui’s[33].

Table 4.2. Sources of distribution data where Maui’s dolphins have been confirmed by DNA analysis.

Author(s) and/or Source	Season	Distance Offshore	Year	Area Covered
DOC (unpubl. historical data)	Various	Various	Various	Kaipara Harbour to Wellington Harbour
Pichler and Baker (2000)	Various	N/A	Various	Kaipara Harbour to Whanganui
Pichler (2002)	Various	N/A	Various	Kaipara Harbour to Whanganui
Baker et al (2012)	Spring/Summer	N/A	2001 to 2006	Kaipara Harbour to Tirua Point
Hamner et al (2012)	Summer	1 nautical mile	2010, 2011	North Kaipara to south Tirua Point

[31] Wade et al in Appendix 1 in Currey et al (2012)
[32] ‘Confirmed’ means a sample was taken from the observed or beach-cast dolphin for genetic testing to verify subspecies identity.
[33] Based on mitochondrial DNA and nuclear DNA testing. Sources: Baker et al (2012); Hamner et al (2012).

4.1.8.1 Maui's dolphin alongshore distribution

Key Points

- Historical samples indicate Maui's dolphins inhabited the New Plymouth and Taranaki regions as recently as 1989.
- Since 2001 all genetic sampling of live dolphins off the WCNI has occurred between the Kaipara Harbour and Raglan.
- Genetic sampling between 2001 and 2011:
  - Shows the highest frequency of Maui's dolphin encounters occurs between the Manukau Harbour and south of Port Waikato.
  - Confirms Maui's dolphin presence between the Kaipara Harbour and Raglan.
  - Confirms the most southern sample of a live Maui's dolphin was north of Raglan in 2010.
  - Showed the maximum distance travelled by a single Maui's dolphin alongshore was approximately 80 km over a year, with several moving 30 to 40 km within days to a year.
  - Confirms the presence of Hector's dolphins off the WCNI, but that they represent less than 3 percent of live Hector's and Maui's dolphins sampled.

Historical evidence confirms the Maui's dolphin population off the WCNI occupied a much larger geographic range– including the Taranaki, Whanganui, and Wellington coastal regions (Table 4.3)[34]. Maui's dolphin stranding records point to a contraction in alongshore distribution off the WCNI in recent history that may be coincident with a decline in abundance.

Since 2001, Maui's dolphin sightings and beachcast/stranded have been confirmed along the coast between the Kaipara and Raglan Harbours (Maps 2 and 3 in Appendix 1). The highest concentration of confirmed sightings is found between Manukau Harbour and Port Waikato within 1 nautical mile of the coast. This area is commonly described as the 'core range' for Maui's dolphins, and is supported by recent genetic sampling[35].

All of the genetic sampling of live dolphins conducted between 2001 and 2011 occurred along the coast between the Kaipara Harbour and Raglan[36]. Tissue samples were collected from dolphins observed in this area from January 2001 to March 2011, with most survey effort occurring within 1 nautical mile[37] of the coast (Map 4 in Appendix 1). A total of 89 individuals were sampled alive or dead in this area and time period, including:

- 35 Maui's dolphins sampled alive between 2001 and 2006;
- 32 Maui's dolphins sampled alive between 2010 and 2011;
- 7 Maui's dolphins sampled in both the 2001-06 and 2010-11 periods;
- 13 Maui's dolphins sampled after death between 2001 and 2011, and;
- 2 Hector's dolphin migrants sampled alive between 2010 and 2011.

In summary, the available information indicates that most Hector's and Maui's dolphins observed off the WCNI (particularly between the Kaipara Harbour and Raglan) are likely to be Maui's dolphins.

Southern Distribution

Only one Maui's dolphin has been sampled south of Raglan since 1989. In 2000 a beachcast

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[34] Some historical samples are held at Te Papa Tongarewa, and Puke Ariki museum in Taranaki.
[35] Baker et al (2012), Hamner et al (2012)
[36] Note: The area surveyed extended along the WCNI from North Kaipara to south Tirua point.
[37] Oremus et al (In press): In the 2010 and 2011 surveys approximately 6% of survey effort occurred between 1 and 3 nm offshore.

Maui's dolphin was found in Albatross Bay, Kawhia Harbour. However, historical samples confirm Maui's dolphins occupied the Taranaki region, and were present further south in the Taranaki, Whanganui and Wellington regions (Table 4.3).

Table 4.3. Historical locations of beachcast or stranded Maui's dolphins (subspecies confirmed by genetic testing) found south of Raglan; date of collection ordered by most recent. Source: DOC Hector's and Maui's Incident database[38].

Location	Date
Albatross Bay, Kawhia Harbour, Waikato	5 March 2000
Urenui Beach, Taranaki	12 November 1989
Opunake Beach, Taranaki	8 April 1989
Tongaporutu River, Taranaki	27 September 1988
Oakura Beach, Taranaki	28 August 1974
Castlecliff, Whanganui	1 May 1921
Wellington Harbour	1873

Since 2001 when genetic sampling of live dolphins began, the most southern confirmation of a Maui's dolphin occurred just north of Raglan Harbour in 2010. The uncertainty over whether Maui's dolphins occur south of Raglan comes from the limited genetic sampling south of Raglan since 2001 to confirm subspecies identity where Hector's and/or Maui's dolphins have been observed. Notably Hector's and/or Maui's dolphins have been observed south of Raglan; these sightings are discussed in Section 4.1.9.

Genetic sampling has also established that the home range of Maui's dolphins is greater than previously believed[39]. The maximum distance travelled by a single individual sampled alongshore was 80 km (over a 375 day period), and several dolphins moved in the order of 30 to 40 km (over 3, and up to 363, day periods).

4.1.8.2 Maui's dolphin distribution offshore

Investigations of offshore distribution of Maui's dolphins relies primarily on aerial surveys, meaning sightings may be of Hector's and/or Maui's dolphins as no tissue samples are collected.

The alongshore boat surveys used to conduced biopsy analyses have been concentrated within 1 nautical mile from shore to maximise the likelihood of encounters with groups of dolphins[40]. The objective of the biopsy surveys has been to use genetic capture-recapture to provide estimates of population abundance and trends, rather than establish offshore distribution of Maui's.

4.1.8.3 Maui's dolphin distribution in harbours

Key Points

- Two Maui's dolphins have been found in the WCNI harbours (confirmed by genetic analysis).
  - One dolphin was found beachcast in Kawhia Harbour in 2000.
  - The second dolphin died as a result of entanglement in a net in the entrance of the Manukau Harbour in 2002.

[38] www.doc.govt.nz/dolphinincidents
[39] Hamner et al (2012)
[40] Baker et al.(2012); Hamner et al (2012)

There are two confirmed Maui's dolphins that have been found in the WCNI harbours. The first was a beachcast Maui's dolphin found in Albatross Bay, Kawhia Harbour, in 2000[41]. The second Maui's dolphin was found entangled (likely in a recreational set net) and floating in the Manukau Harbour entrance in 2002[42].

All other available research (including acoustic detections) and sighting information in WCNI harbours does not include supporting genetic analysis to confirm subspecies identity and are therefore addressed in Section 4.1.9.

4.1.9 Distribution of Hector's and/or Maui's dolphins from all data types[43]

4.1.9.1 Sightings sources

Most sightings of Hector's and/or Maui's dolphins during research surveys, and by public and government officials (e.g. conservancy or fishery officers) do not include sampling to confirm subspecies identity. This means the dolphin sightings could be either Maui's or Hector's. Locations of these sightings are shown on Maps 4 (research effort), Map 5 (public sightings) and Map 6 (harbours) in Appendix 1.

Available information on the distribution of Hector's and/or Maui's dolphins off the WCNI (summarised in Table 4.4) includes research survey sightings, sightings by government staff, and public sightings.

Sightings information for Hector's and/or Maui's dolphins off the WCNI from 2000 to 2009 was summarised in 2010[44]. In addition, DOC holds their Hector's and Maui's dolphin sightings information in the DOC sightings catalogue[45]. Both sources contain sighting information from regional DOC offices records, independent research study sightings, DOC-led surveys, government officials (DOC and Ministry of Fisheries/Ministry for Primary Industries staff), and the public.

Table 4.4. Sources of recent distribution data for Hector's and/or Maui's dolphins, (adapted from Du Fresne 2010).

Author(s) and/or Source	Season	Distance Offshore (nautical miles)	Year	Area Covered
Ferreira and Roberts (2003)	Summer	5	2000/01 and 2001/02	North Cape to Paraparaumu
Slooten et al (2005) Slooten et al (2006)	Summer, Winter	5 or 10	2004	Maunganui Bluff to New Plymouth
Scali (2006)	Winter	10	2006	Muriwai to Carters Beach
Rayment and Du Fresne (2007)	Spring	10	2007	Muriwai to Carters Beach
Childerhouse et al (2008)	Winter	10	2008	Muriwai to Carters Beach
Stanley (2009)	Winter	10	2009	Baylys Beach to Kawhia Harbour
DOC (unpubl. data)	Various	Various	Various	Sightings made during various alongshore surveys, in addition to recent harbour-focused efforts
DOC (unpubl. data)	Various	Various	Various	Opportunistic sightings reported by members of the public

[41] Duignan et al (2003). Dolphin was too decomposed to determine its cause of death, but signs of recent feeding suggested a sudden death, which the authors speculate may possibly relate to entanglement.
[42] The entrance area of the Manukau Harbour has been closed to recreational and commercial set netting since 2003.
[43] All WCNI research, sightings, strandings, and acoustic detection data are discussed including where subspecies identity is not confirmed.
[44] Du Fresne (2010)
[45] Before identification of the Maui's dolphin subspecies in 2002, Maui's dolphin sightings and mortalities on the WCNI were generally recorded as North Island Hector's dolphins. The first sighting was reporting in 1922, however, regular sightings began in the 1970s.

4.1.9.2 Sightings reliability

MPI and DOC consider that a scale of reliability can be applied to sighting information to support analysis of Hector's and/or Maui's dolphin distribution off the WCNI (Table 4.5). That is, the sightings observed are that of the Hector's and/or Maui's dolphins and not any other dolphin species. The scale of reliability is a continuum from most reliable (and least uncertain, that is Category 1) to least reliable (and most uncertain or likely another species, that is a Category 5)[46].

Table 4.5. Categories for ranking the reliability of sightings of Hector's and/or Maui's dolphins off the west coast of the North Island. Examples provided do not cover the full range of possible sightings for each category.

Category	Description	Examples
1	Report from a source of known reliability; or High quality photo with landmark; or High quality photo with no landmark but detailed description of location.	Duplicate research sightings Research sightings made by an individual researcher
2	Description provided that is consistent with a Hector's and/or Maui's dolphin, detailed location description and/or GPS position.	DOC or MPI staff sighting with GPS position Verified public sighting with GPS position
3	Description provided that is consistent with a Hector's and/or Maui's dolphin, but the location is outside the known current range of the species.	Research sightings made by individual 'inexperienced' researcher Sighting made from an oil platform, further offshore than regularly observed
4	Description is inconsistent with a Hector's and/or Maui's dolphin.	Unverified public sightings with or without GPS position
5	The report is for a South Island location (Hector's dolphin); or The report is incomplete. The interview does not enable the report to be scored in any of the previous categories; or The interview was not able to be conducted; or The report is another dolphin species.	Any sighting without GPS position given. Any sighting with an unreliable GPS position given. Sighting information is unverifiable or consistent in describing another species.

Research surveys are undertaken using standardised protocols and methods, which are conducted by trained observers specifically looking for Hector's and Maui's dolphins. Within research survey sightings, those made by two observers of the same individual dolphin or group of dolphins (known as a 'duplicate' sighting) provides the greatest level of certainty[47].

Anecdotal public sightings are largely subjective and their robustness is more difficult to quantify than scientific information. Most public sightings of Hector's and/or Maui's dolphins have been recorded within 4 nautical miles from shore, as most recreational activities occur close to shore. Public sightings are subject to a systematic validation procedure. Those sightings given high scores are more reliable than unverified public sightings (for example, Categories 1 and 2 versus 4 and 5). Public sightings within the DOC sightings catalogue have been subjected to a systematic validation procedure since 2004.

Verification of public sightings considers whether evidence of the sighting is provided and

[46] Note that the reliability scale is not linear with research sightings considerably more reliable than DOC and Ministry staff sightings. Verified public sightings vary in their reliability depending on the category given during the verification process. Unverified public sightings and any without a GPS position are much less reliable than sightings made by researchers, or DOC and Ministry staff.

[47] For example, Rayment and Du Fresne (2007)

previous track record of accurate sightings[48]. The validation procedure includes interviews conducted either by DOC staff or an experienced marine mammal scientist using a standardised interview process. From June 2012 all validation interviews have been undertaken by an independent marine mammal scientist.

Verified public sightings provide the most robust anecdotal evidence about Hector's and/or Maui's dolphin distribution (Map 5 in Appendix 1 shows the public sightings that have been verified as Category 1, 2, or 3, indicating a higher reliability). Details of sighting information relevant to discussion of alongshore, harbour, and offshore distributions are discussed below.

4.1.9.3 Hector's and/or Maui's dolphins alongshore distribution off the WCNI

Key Points

- The most southern sighting by DOC staff of a Hector's and/or Maui's dolphin was just south of the Mokau River.
- Public sightings of Hector's and/or Maui's dolphins have been reported throughout the Taranaki region, and includes two sightings supported by video/photographic evidence

Most Hector's and/or Maui's dolphin sightings occur between the Kaipara and Raglan Harbours (Maps 4 and 5 in Appendix 1). The highest concentration of sightings is found between Manukau Harbour and Port Waikato within 4 nautical miles of the coast.

Two live Hector's dolphins have been genetically sampled between the Kaipara Harbour and Raglan. In addition, two Hector's dolphin mortalities off the WCNI have been confirmed (one in the Manukau Harbour in 2011, and the other stranded on Kina Roach Beach near Opunake, south of Cape Egmont in 2012).

In summary, the available indicates that most Hector's and/or Maui's dolphin sightings off the WCNI occur along the coast between the Kaipara Harbour and Raglan.

Southern Distribution
Historical strandings of Hector's and/or Maui's dolphins off the WCNI have been found in the Taranaki, Whanganui, and Wellington coastal regions (Table 4.6). No samples were taken to confirm subspecies identity of these individuals.

The most southern sighting by DOC staff of a Hector's and/or Maui's dolphin was reported just south of the Mokau River in 2008 (DOC, unpublished). Public sightings of Hector's and/or Maui's dolphins have been reported to DOC from north of the Kaipara Harbour south throughout the Taranaki area (Map 5 in Appendix 1).

[48] Russell (2008)

Table 4.6. Historical locations of beachcast or stranded Hector's and/or Maui's dolphins (subspecies identity unknown) found south of Raglan; date of collection ordered by most recent. Source: DOC Hector's and Maui's Incident database.

Location	Date
Oakura Beach, Taranaki	6 December 1988
Castlecliff, Whanganui River, Whanganui	11 March 1988
Onareo Beach, Taranaki	14 December 1985
Onareo Beach, Taranaki	17 April 1979
Mokau River Mouth, Taranaki	11 March 1979
Tongaporutu River, Taranaki	5 February 1979
Waiiti, Taranaki	26 January 1979
Oakura Beach, Taranaki	24 August 1975
Pukearuhe, Waiiti, Taranaki	1 January 1973
Waikanae, Kapiti Coast	1 January 1967
Nukuhakari Beach, Waikato	20 December 1953

The alongshore distribution of Maui's dolphins off the WCNI may extend further south than Pariokariwa Point and Oakura; the southern boundaries of the fishing-, and non-fishing-, related management measures, respectively, put in place after the 2008 TMP. Information to support this includes the:

- historical samples from stranded and beach-cast Maui's dolphins in the Taranaki, Whanganui and Wellington regions;
- southern most sighting of Hector's and/or Maui's dolphins by DOC staff, and maximum travel distance by Maui's dolphins observed to date;
- public sightings of Hector's and/or Maui's dolphins reported south of Pariokariwa Point and in the Taranaki Bight, which include two Category 1 sightings, both of which were supported by video/photographic evidence[49], and;
- the mortality of a Hector's or Maui's dolphin in a commercial set net off the coast of Cape Egmont.

The uncertainty over whether Maui's dolphins occur south of Pariokariwa Point and Oakura comes from the:

- lack of research sightings in the area;
- small number of verifiable public sightings, and;
- limited amount of genetic sampling south of Raglan to confirm subspecies identity where Hector's and/or Maui's dolphins have been observed.

This uncertainty is influenced by a range of factors, including:

- the small population size;
- the snap shot nature of research surveys (as they are undertaken for a limited period and reliant on suitable weather/sea conditions);
- the lower amount of research survey effort south of Raglan and especially south of New Plymouth (that is, more effort has been focused where observations are more likely to occur), and;
- genetic evidence confirming a Hector's dolphin stranding in the Taranaki region south of Pariokariwa Point.

[49] One sighting occurred south of Waiongona (south of Waitara) in 2009 and the other in Port Taranaki in 2007.

4.1.9.4 Hector's and/or Maui's dolphin offshore distribution

Key Points

- Research on the offshore distribution of Maui's dolphins relies heavily on aerial surveys, which means sightings may be of Hector's and/or Maui's dolphins as no tissue samples are collected for genetic testing.
- Research and government/public sighting information suggests that Hector's and/or Maui's dolphins off the WCNI are most prevalent in the area from shore to 4 nautical miles offshore.
- There have been seven aerial research surveys across six years that included areas beyond 4 nautical miles offshore of the WNCI. The most reliable survey sightings observed five separate occurrences of Hector's and/or Maui's dolphins outside 4 nautical miles.
- Best available information suggests Hector's and/or Maui's dolphins off the WCNI are present in the area beyond 4 nautical miles from shore, although the extent of their presence is unknown

Research and sighting information suggests that Hector's and/or Maui's dolphins off the WCNI are most prevalent in the area between shore and 4 nautical miles, but are also sometimes present in the area beyond 4 nautical miles from shore. There have been seven aerial research surveys across six years that included areas beyond 4 nautical miles off the WCNI. These surveys sighted nine separate occurrences of Hector's and/or Maui's dolphins outside 4 nautical miles; the validity for which four is more uncertain (Table 4.7).

Table 4.7. Distance offshore of the west coast North Island where Hector's and/or Maui's dolphins have been reported more than 4 nautical miles offshore during aerial research surveys, and by the public between 1982 and 2009 (listed from most to least reliable).

Description	Distance offshore (nautical miles)	Date	Source
Duplicate research sighting	4.05**∞	October 2007	Rayment and Du Fresne (2007)
Single research sighting	4.30*∞	May 2008	Childerhouse et al (2008)
	4.49*∞	August 2006	Scali (2006)
	6.18*∞	June 2009	Stanley (2009)
	6.87∞?	August 2006	Scali (2006)
Verified public sighting with GPS	8.65	February 2002	DOC catalogue #226
Single research sighting (inexperienced observer)	8.20*φ	August 2006	Scali (2006)
	9.20*φ	August 2006	Scali (2006)
	9.70*φ	August 2006	Scali (2006)
	10.30*φ	August 2006	Scali (2006)
Unverified sightings with GPS	4.28	July 2004	DOC catalogue #202
	5.33	April 2009	DOC catalogue #560
	67.17	April 1982	DOC catalogue #4641
Unverified sightings with no GPS	5.00	February 2009	WWF 2010

** Indicates a duplicate research sighting of Maui's dolphins
*Indicates a single researcher sighting of Maui's dolphins
φ Indicates a less reliable sighting due to concerns about observer inexperience (Scali 2006)
∞Indicates a more reliable sighting by appropriately experienced observers under suitable survey protocols (Du Fresne 2010).

The only duplicate sighting of Hector's and/or Maui's dolphins beyond 4 nautical miles from shore occurred during the 2007 survey, where two researchers saw the same two Hector's and/or Maui's dolphins at 4.05 nautical miles from shore[50].

Some surveys have not resulted in any sightings beyond 4 nautical miles[51]. However, these surveys predominantly sampled in summer and observations suggest that the Hector's and/or Maui's dolphins observed off the WCNI are distributed further offshore more often during winter than summer[52]. For example, one study found most summer sightings (75 percent) occurred within one nautical mile of shore, compared to 33.3 percent in the winter[53]. However, the maximum offshore distances between summer and winter were similar at 3.09 and 3.33 nautical miles, respectively. In addition, the aerial and boat-based surveys have also focused a greater amount of effort within 5 nautical miles from shore, thereby limiting their ability to detect any Hector's and/or Maui's dolphins offshore beyond 4 nautical miles.

There are uncertainties associated with some of the offshore sighting's information. The Scali (2006) survey highlighted some concerns with the validity of the findings[54]. However, although the survey was not formally peer reviewed, both DOC and an independent researcher[55] consider the survey design to be consistent with the design of peer reviewed surveys that are considered reliable[56]. Two sightings reported by Scali (2006) at 4.49 and 6.87 nautical miles from shore were made by researchers considered to be experienced, and are considered to be reliable. Other sightings beyond 4 nautical miles from shore (those at 8.20, 9.20, 9.70 and 10.30 nautical miles) were considered unreliable due to concerns about observer inexperience although they had undertaken some training[57].

Research establishing that Hector's and Maui's dolphins prefer waters within the 100 m depth contour has only been undertaken for Hector's dolphins on the South Island, which has shown that dolphins can regularly be seen out to the 100 metre depth contour[58]. It is, however, unknown how significant the 100 metre depth contour is to the distribution of Maui's dolphins off the WCNI. Aerial and boat surveys have observed Maui's most often within 4 nautical miles of shore and present out to 7 nautical miles. The observations reported beyond 7 nautical miles are considered less reliable. It is unknown what the offshore limit is of Maui's dolphins, and how often and how far they may travel offshore. The ability to detect these limits is difficult given their low abundance.

The uncertainty over whether Maui's dolphins off the WCNI make infrequent visits outside 4 nautical miles comes from a relatively small number of research sightings beyond 4 nautical miles. This uncertainty may be influenced by a range of factors, including the:

- small population size;
- snap shot nature of boat-based and aerial surveys (that are undertaken for a limited period and reliant on suitable weather/sea conditions);
- limited survey effort past 4 nautical miles (ie, more effort has been focused on

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50 Rayment and Du Fresne (2007)
51 Documented by Ferreira and Roberts (2003), Slooten et al (2005, 2006)
52 Slooten et al (2006)
53 Slooten et al (2005)
54 Concerns included: the relatively high number of Maui's dolphin sightings in one flight when sea conditions were not perfect and that many of the sightings happened further offshore than expected. The researcher also noted a high inconsistency between observers, suggesting that inexperience of some of the surveyors may have contributed to these inconsistencies and to the uncertainty around the findings in general.
55 Du Fresne (2010)
56 For example: Ferreira and Roberts (2003), Slooten et al (2005), Slooten et al (2006)
57 Du Fresne (2010)
58 Rayment et al (2010); Du Fresne and Mattlin (2009)

alongshore distribution);

- limited survey effort conducted in winter (changes in Hector's and/or Maui dolphin behaviour and distribution seasonally is uncertain), and;
- lack of genetic analyses to confirm that sightings from aerial surveys are solely Maui's dolphins.

In summary, the available information indicates that Hector's and/or Maui's dolphins observed off the WCNI are sometimes present beyond 4 nautical miles from shore although the extent of their presence in this area is unknown.

4.1.9.5 Hector's and/or Maui's dolphin distribution in harbours

Key Points

- Research sightings of Hector's and/or Maui's dolphins have occurred in the entrances of the Manukau, Raglan, Aotea and Kawhia harbours.
- Acoustic detections of Hector's and/or Maui's dolphins include:
  - A single acoustic detection recorded in the Kaipara Harbour in 2007 approximately 10 km south of the harbour side of the entrance beyond the current set net prohibitions.
  - A total of 37 acoustic detections recorded in the Manukau Harbour in 2005 and one acoustic detection in 2007 within the current set net ban area.
- Public sighting information is variable, but suggests Hector's and/or Maui's dolphins occasionally travel within the harbour entrances.
- There is no information to indicate how often or how far Hector's and/or Maui's dolphins observed may travel into WCNI harbours beyond the entrances.

Information suggests that Hector's and/or Maui's dolphins do use WCNI harbours, although the frequency and extent of that use is unknown[59]. There have been two boat surveys[60] and one acoustic survey programme[61] that have sampled within harbours to determine the distribution of, or use by, Hector's and/or Maui's dolphins.

In addition there have been some reported sightings of Hector's and/or Maui's dolphins by both the public and government officials in WCNI harbours, particularly in the entrances or channels (Map 6 in Appendix 1). This information is summarised in Table 4.8[62].

[59] In addition to the Maui's dolphin mortalities discussed above (section 4.1.8.3) there was a Hector's dolphin mortality recorded in the Manukau Harbour in 2012.
[60] Hamner et al (2012): Undertaken during the 2010 and 2011 February – March periods.
[61] Rayment et al (2011): Monitoring was partitioned into austral summer (October – March) and austral winter (April – September) among four harbours (Kaipara, Manukau, Raglan, and Kawhia) between October 2005 and August 2008.
[62] Baselines used to define the boundaries of harbour entrances (obtained from LINZ – Land Information New Zealand) were used to determine what sightings occurred within the harbours. They do not differentiate between sightings in channels, at the entrance or mouths given the variability in how these descriptions could apply to each harbour.

Table 4.8. Hector's and/or Maui's dolphin sightings (public, research, government) or acoustic detections in the WCNI harbours.

Information	Kaipara	Manukau	Raglan	Aotea/Kawhia
Public sightings[63] (All categories, 1922 to present)	9	38	43	1 7
Public sightings, (Categories 1-3, 2004 to present)	3	3	9	0
Research sightings	1	17 (not incl. acoustic)	2	4
DOC/MPI sightings	0	3	6	1
Acoustic surveys	1 detection	38 detections	0	0

The use of acoustic monitoring methods often has higher detection rates for target species that are cryptic or occur at low densities than the use of visual surveys[64]. The detection range for T-PODS[65] provides for limited spatial coverage (for eample, an effective detection radius of ~198 metres and a maximum detection range of ~431 metres). This means a dolphin needs to be relatively close and oriented towards the T-PODS to be detected[66].

Passive acoustic monitoring[67] has detected Hector's and/or Maui's dolphins inside the Manukau and Kaipara Harbours[68]. The T-POD data showed a single acoustic detection occurred in the Kaipara Harbour (2006) approximately 10 km inside the Kaipara harbour, south of South Head. The detection radius of the T-PODS shows the Hector's or Maui's dolphin was well inside the Kaipara Harbour beyond the area currently subject to fishing-related restrictions. There were 38 acoustic detections in the Manukau Harbour; 37 detections were recorded in November 2005 (on 5 different days, 4 of which were consecutive) and a single detection in November 2007. All the Manukau Harbour detections occurred in the entrance area currently subject to fishing-related restrictions.

In summary, the available information suggests that Hector's and/or Maui's dolphins have entered the Kaipara, Manukau, and Raglan Harbours, although the frequency and extent of the use of those harbours is unknown and unable to be inferred from presently available information. The uncertainty in Hector's and/or Maui's dolphins' use of WCNI harbours is influenced by a range of factors, including the:

- small population size;
- lack of genetic sampling to confirm subspecies of Hector's and/or Maui's dolphins sighted or acoustically detected in the harbours;
- snap shot nature of aerial or boat-based surveys (that are undertaken for a limited period and reliant on weather/sea conditions), and;
- limited survey effort in WCNI harbours, particularly the Raglan, Kawhia and Aotea harbours.

[63] Sighting reliability is category 3, outside current known range of Hector's and/or Maui's dolphin distribution off the WCNI
[64] Mellinger et al (2007)
[65] T-PODS are an instrument used for detecting and logging dolphins and whales by listening to the noises they make.
[66] Rayment et al (2009b)
[67] Passive acoustic monitoring means inactively listening to the sources of sound.
[68] Rayment et al (2011). The detections recorded in the harbours may have underestimated the presence of Maui's dolphins based on the methods and decision rules used to classify the detections. A large number of detections were excluded because of spurious noise generated by non-biological noise (for example, sediment noise created by waves or tidal movements) that masked genuine dolphin noise or created false detections.

4.1.10 Status of the species

Key Points

- Maui's dolphins are a threatened species in New Zealand
- Under the New Zealand Threat Classification System they are classified as Nationally Critical
- Under the International Union for the Conservation of Nature Red List Categories and Criteria they are classified as Critically Endangered
- Both classifications indicate the Maui's dolphin is facing a high risk of extinction

Maui's dolphins were declared a "threatened species" by the Minister of Conservation in 1999. In addition to their threatened species status, there are two classification systems that have been applied to the Maui's dolphin population: the New Zealand Threat Classification System and the International Union for the Conservation of Nature (IUCN) Red List Categories and Criteria.

The New Zealand Threat Classification System has been developed by the DOC and sets out a system for classifying species according to the threat of extinction using criteria that has specifically been developed for New Zealand[69]. There are seven rankings within the Threat Classification System. The highest ranking is Nationally Critical, followed by Nationally Endangered through to the lowest ranking, Range Restricted. Maui's dolphins were given a threat ranking of Nationally Critical and their survival and recovery is considered Conservation Dependent[70]. The four main parameters used to assign threat ranking were total population size, population trend, geographical range, and whether the subspecies has been directly or indirectly affected by humans[71].

The second classification system that applies to Maui's dolphins is the International Union for the Conservation of Nature (IUCN) Red List Categories and Criteria. This is the international system for classifying species at high risk of global extinction. There are seven categories described for ranking species according to the IUCN Red List and Categories Criteria. In order of severity these are: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, and Of Least Concern. Under the criteria, Maui's dolphin has been classified as Critically Endangered, such that the best available evidence indicates that this subspecies is considered to be facing an extremely high risk of extinction.[72]

Both of these threat classifications indicate that active management is required to mitigate human impacts.

4.1.11 Social and cultural value of Hector's and Maui's dolphins

Hector's and Maui's dolphins are found only in New Zealand waters and are New Zealand's only endemic dolphin species. As one of the world's rarest dolphins, they are viewed as a very special component of New Zealand's and the world's marine biodiversity. With the increase in public awareness of the marine environment and our knowledge of marine species and ecosystems, Hector's and Maui's dolphins have become a symbol of marine species conservation in New Zealand.

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[69] Molloy et al (2002)
[70] Baker et al (2010): Conservation Dependent means the subspecies is likely to move to a higher threat category if current management ends.
[71] Townsend et al (2008)
[72] Reeves et al (2008)

Hector's and Maui's dolphins are revered as a taonga by Maori. Tutumairekurai is the most common of the Maori names for Hector's and Maui's dolphins, meaning ocean dweller. Some Maori believe that the spirits of the dead become tutumairekurai. Te Aihe a Maui, Te ika a Maui, Papakanua, Tūpoupou, Popoto, and Upokohue are other names also used.

Social values relating to Hector's and Maui's dolphins have been reflected:

- in government policy[73];
- in petitions to parliament and letters to Ministers about the conservation of Hector's and Maui's dolphins, and;
- through general social commentary in the media.

In general, there is an expressed desire for greater Maui's dolphin abundance and fewer (or no) human-induced deaths.

New Zealand is internationally recognized for its management of the marine environment. In particular, it is known for its stance on marine mammal issues such as whaling and has a strong presence in the international community regarding marine mammal protection and conservation issues. New Zealand's management of marine mammals in national waters is therefore of significant international interest.

[73] Conservation General Policy 2005, 4.4(f) *Protected marine species should be managed for their long-term viability and recovery throughout their natural range*.

4.2 VULNERABILITY OF THE MAUI'S DOLPHIN POPULATION TO HUMAN-INDUCED THREATS

Key Points

- Potential Biological Removal (PBR) analysis is intended to provide an indication of the vulnerability of Maui's dolphins to human-induced impacts.
- The PBR analysis estimates the maximum number of human-induced dolphin mortalities that may occur while allowing the stock to reach or maintain its optimum sustainable population size with high probability.
- The most recent PBR analysis for Maui's dolphin:
    - Estimates the population can sustain one human-induced mortality every 10 to 23 years
    - Suggests that this population can only sustain very low levels of human-induced mortality from all sources of impact.

The following biological characteristics of Maui's dolphins make them vulnerable to the effects of human-induced mortality. Maui's dolphins:

1. Become sexually mature at a relatively late age (about 7-9 years).
2. Are relatively short lived (up to 22 years).
3. Have a low reproductive rate (a female has a single calf every 2-3 years).
4. Favour shallow waters less than 100 m deep and have a localised inshore distribution (i.e. overlap with many human coastal activities).
5. Have a small population (and consequently may have few breeding females).

The Maui's dolphin population appears to be maintaining an equal sex ratio, or potentially a slight female bias, which would potentially be favourable for reproduction. However, even if one assumes an even sex ratio, the number of mature females may be less than one quarter of the population, resulting in extremely low productivity potential.

Small population size couple with low productivity may suppress the population growth rate even in the absence of human-induced mortality. Depensation and stochastic events (for example, disease and catastrophic weather) may remain very real extinction threats[74].

In addition to having a low population growth rate, Maui's dolphins appear to more frequently undertake small-scale movements rather than large-scale movements, which could increase their susceptibility to population fragmentation. Although larger than previously believe, their home range is still small in comparison with other species with an average alongshore home range of at least 35.5 km[75].

Potential Biological Removal (PBR) analysis is intended to provide an indication of the vulnerability of Maui's dolphins to human-induced impacts. The PBR analysis estimates the maximum number of human-induced dolphin mortalities, which may occur while allowing the population to reach or maintain its optimum sustainable population (OSP) size with high probability.

[74] Depensation is a negative effect on population growth that becomes proportionately greater as population size declines. Populations experiencing depensation are prone to further reductions in size, even in the absence of extinction, and therefore have a greater risk of extinction.

[75] Oremus et al (In press)

DOC has commissioned an updated PBR estimate for Maui's dolphins based on the most recent estimate of population abundance[76]. The updated PBR estimates the Maui's dolphin population can sustain one human-induced mortality every 10 to 23 years[77].

PBR modelling gives an indication of how much human-induced mortality a population can sustain and recover to its maximum net productivity level. For Maui's dolphins the PBR analysis suggests that this population can only sustain very low levels of human-induced mortality from all sources of impact.

PBR analysis relies on estimated or known biological and variable inputs. Where the uncertainty of the inputs is high, PBR provides a general indication of the vulnerability of the population to mortalities. Additionally, PBR analysis assumes a population target size of OSP. While OSP is recognised as a good target population size because it results in the maximum productivity of a population, it is not a legislated target.

[76] Wade et al , Appendix 1 in Currey et al. (2012)
[77] This assessment of PBR (Wade 1998) assumes the following input values: a minimum abundance estimate of 48 (the lower 20th percentile (log-normal) of the estimate from Hamner *et al.* 2012), a recovery factor of 0.1 (Taylor *et al.* 2003), and a maximum net productivity rate of either 0.018 (Slooten and Lad 1991) or 0.04 (Wade 1998).

5.0 Threats to Maui's dolphins

There are many actual and potential threats facing Hector's and Maui's dolphins, including fishing-related mortality (for example, through net entanglement), boat strike, pollution, disease, mining and tourism impacts. Some of these threats are a direct cause of dolphin mortality, where others may impact on the population through sub-lethal impacts (for example, reducing reproductive success and habitat degradation).

For the review of the Maui's dolphin portion of the TMP in 2012, a risk assessment workshop was convened to identify, analyse and evaluate all threats to Maui's dolphins. It also identified those threats that pose the greatest risk to achieving management objectives of the TMP[78]. The range of potential threats identified is set out below, along with a general description of their impacts.

The risk assessment workshop was facilitated by scientists from the Royal Society of New Zealand, MPI and DOC. The risk assessment scoring was conducted by an expert science panel ('the panel') that considered all of the known actual or potential threats to Maui's dolphins based on the estimated degree of overlap between the dolphin distribution and the distribution of the threat. The risk assessment sought to identify threats that were likely to affect population trends within the next five years. While these more immediate threats form the primary focus of the proposals by MPI and DOC, there are a number of longer-term threats that may also impact on the long term viability Maui's dolphins.

The panel estimated that 1 to 8 Maui's dolphin mortalities (a median of 5) were likely to occur each year from all threats over the next five years. The broad confidence limits for this estimate reflect the uncertainty within and between panellists.

Fishing-related activities accounted for about 95 percent of total estimated mortalities compared with 5 percent from mining and oil activities, vessel traffic, pollution and disease combined. Within fishing-related activity, commercial and non-commercial set net fisheries were estimated to have a greater impact on Maui's dolphins than commercial trawling. The assessed level of Maui's dolphin mortalities (all threats combined) is 75.5 times the level of PBR. All threat categories had a $\geq$ 30 percent likelihood of exceeding the PBR in the absence of other threats.

The risk assessment panel's estimates suggest that there is a 95.7 percent likelihood of the population declining over the next five years. Based on the total estimated number of Maui's dolphin mortalities it was projected that the population will decline by 7.6 percent each year for the next five years.

The nature of all potential threats to Maui's dolphins is set out below, along with a general description of their impact(s). DOC maintains a database relating to Hector's and Maui's dolphins, which includes information about reported incidents involving mortality (such as beach-cast animals, bycatch and boat strike) and also incidents such as live strandings (Table 5.1). Many of the incident reports were sourced from Government agencies other than DOC or from research institutes. A standardised incident reporting procedure, in place since 1994, means most incidents include a standard set of data and photographs. Necropsies are undertaken where possible to help establish cause of death. Regular updates of this database including links to pathology reports can be found online at www.doc.govt.nz/dolphinincidents.

[78] Currey et al (2012)

Table 5.1. Reported mortalities of Hector's and/or Maui's dolphins off the WCNI between 1921 and July 2012. Source is the DOC Hector's and Maui's Dolphin Incident database.

Description of Incident	Incidents
Known entanglement – animal was known (from incident report) to have been entangled and died. [79]	3
Probable entanglement – net marks on the body and one other definite indication of capture such as mutilation; or the pathology report lists probable entanglement as cause of death	1
Possible entanglement – net marks on the body and a mention of the net marks in the incident report; or the pathology report lists probable entanglement as cause of death	2
Human interaction – no sign of net entanglement but definite signs of other types of human interaction such as high degree of mutilation.	1
Possible human interaction – no signs of net entanglement but indications of other types of human interaction such as marks that resemble knife wounds.	1
Not determinable – carcass too decomposed for necropsy.	7
Unknown – cause of death unexplained or not definitive (eg, "open" diagnosis in pathology report).	3
Biological – cause of death deemed to be from natural causes, including disease[80]	4
Not assessed – carcass was not necropsied or recovered, or the cause of death was not assessed (typical of historical mortalities).	24
TOTAL	46

5.1 HUMAN-INDUCED THREATS TO MAUI'S DOLPHINS

5.1.1 Fishing threats

Because Maui's dolphins have a close inshore distribution, their range overlaps with commercial and non-commercial set net fisheries, and inshore trawl fisheries. Fishing-related mortality through net entanglement is recognised as the greatest single threat to Maui's dolphins off the WCNI (Table 5.1).

5.1.1.1 Set net

Key points

- Dolphins are known to be susceptible to being entangled in set nets because:
  - Dolphins have been observed entangled in set nets.
  - Dolphin distribution overlaps with commercial and amateur set net fisheries.
  - Dolphins are not able to detect monofilament nets which make them susceptible to entanglement.
  - Dolphins need to surface to breathe so they are susceptible to drowning if caught in set nets.
- There have been 46 reported Hector's and/or Maui's dolphin mortalities between 1921 and April 2012 off the WCNI.
- Reported mortalities probably only provide an indication of the nature of the threats from fishing to the dolphins, as the cause of death is established for only 12 of the 46 reported mortalities.
- Of the 46 reported mortalities between 1921 and 2012, there are 3 known set net related mortalities, and 3 other mortalities show evidence of net marks or other indications of interaction with fishing with nets.

[79] Two confirmed Maui's dolphins, the other a Hector's or Maui's dolphin as carcass was not recovered.
[80] Two of the three natural causes relate to Toxoplasmosis.

The definition of set net in fisheries regulations is broad and encompasses most fishing methods and gear that enmesh fish. Most often the practice of set netting involves the placing of a net, either in mid-water, or on or near the sea floor (Figure 5.1). Set nets are made from fine nylon, so fish can't detect them. Set nets are non selective and catch marine life that swims into them and gets tangled. Fish bigger than the net's mesh size get tangled in the net by their gills or fins; smaller fish swim through the net.

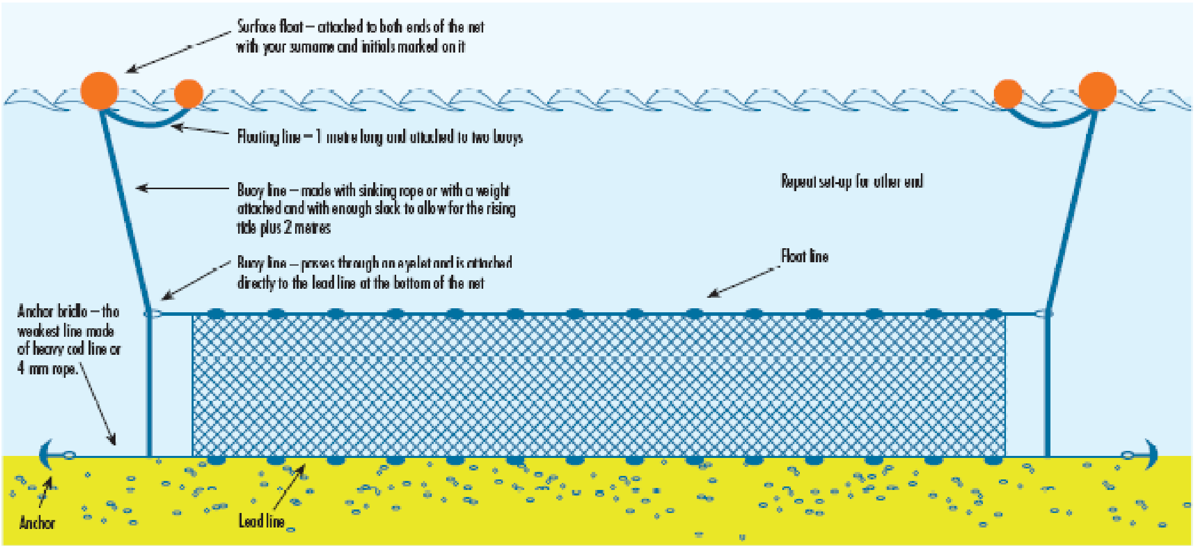

Figure 5.1. Features of a typical set net.

Set netting usually occurs in shallow waters within a few miles of the coast, and the nets are often left unattended and/or overnight. Recreational fishers may only use one set net that does not exceed 60 metres in length, unless on a vessel where two set nets may be used provided they have the proper mesh size and do not exceed 10 metres in length. Recreational set netters are also not permitted to set their net within 60 metres of any other net. [81]

Commercial fishers are restricted to using a set net (or a combination of nets) that are no greater than 1000 metres in total length, unless they are operating in waters where the upper edge of the set net is more than 2 metres below the sea surface[82]. In that circumstance commercial fishers are restricted to using a set net (or a combination of nets) that are no greater than 3000 metres in total length. Commercial set nets can be up to 10 metres high and are often set sequentially, with multiple nets extending over kilometres.

The vulnerability of Hector's and Maui's dolphins to net entanglement, particularly in inshore set nets, has been established through a combination of interviews with fishers, independent observer programmes and necropsies of by-caught and beach-cast animals. The summer period is considered the time of year when Hector's and Maui's dolphins are at most risk of set net entanglement.

The DOC Hector's and Maui's Incident database is used to record information about human interactions with these dolphins across the whole of New Zealand. The information in this database shows that 14 percent of the total reported incidents, 37 percent of incidents where information on the cause of death is available, and 70 percent of incidents where cause of

[81] Refer to Fisheries (Amateur Fishing) Regulations 1986.
[82] Refer to Fisheries (Commercial Fishing) Regulations 2001.

death is entanglement, are attributable to set net entanglement[83]; indicating that set netting is the greatest known cause of human-induced Hector's and Maui's dolphin mortalities.

A subset of these reports can be extracted for just the WCNI (shown above in Table 5.1). In this area a total of 46 reported Hector's and/or Maui's dolphin mortalities off the WCNI between 1921 and July 2012. Reported mortalities likely only provide an indication of the nature of the threats from fishing to the dolphins, as the cause of death is established for only 12 of the 46 reported mortalities (approximately 26 percent). Of the 46 reported mortalities there are 3 known set net related mortalities, and 3 other mortalities that show either evidence of net marks or other indications of interaction with fishing nets, accounting for 50 percent of mortalities where cause of death can be assessed.

5.1.1.2 Trawling

Key points

- Dolphins are known to be susceptible to being entangled in trawl nets because:
  - Dolphins have been observed entangled in trawl nets;
  - Dolphin distribution overlaps with commercial trawl fisheries;
  - Dolphins need to surface to breathe so they are susceptible to drowning if caught in trawl nets.
- Of the 46 reported mortalities of Hector's and/or Maui's dolphins off the WCNI between 1921 and 2012, none have been attributed to interaction with trawl nets.
- Of all reported entanglements of Hector's and Maui's dolphins in the DOC incident database, trawling has caused 20 of the 117 (17 percent) known entanglements.

Trawling involves towing a specialised net. Steel paravanes (trawl doors) are adjusted to "fly" through the water in opposing directions and hold the mouth of the net open. The net is set to herd fish into its mouth, and eventually into the cod end (Figure 5.2). In New Zealand, most trawling is carried out near the bottom, and in water depths ranging from around 10 metres to more than 1000 metres deep.

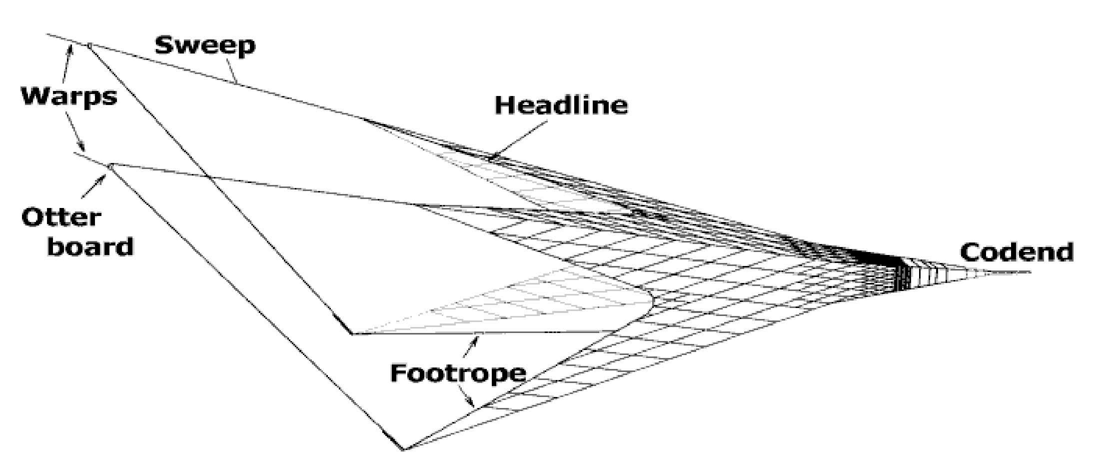

Figure 5.2. Features of a Trawl Net[84]

There have been no reported mortalities of Maui's dolphins where the cause of death can be attributed to trawling. However, Hector's dolphins have been known to become caught by

[83] Since 1921 when the first incident was recorded. Natural mortalities are included in the database.
[84] Source: Australian Fisheries Management Authority. South East Trawl Fishery Bycatch Action Plan (2001). http://www.afma.gov.au/

inshore trawl vessels where nets are towed along the sea floor or in mid-water. Total reported instances of Hector's dolphins caught in trawl nets are low compared to set nets. However, the focus of observer programmes and interview programmes to assess Hector's dolphin bycatch off the South Island has tended to target set net fisheries. Nevertheless, the incident rate (per day fishing) appears to be lower for trawl than set net fisheries.

Since 1921, there have been 20 reported Hector's dolphin mortalities definitely attributable to trawling (around 6 percent of incidents with a known cause of death). All of these incidents were in South Island trawl fisheries and occurred within 2 nautical miles from shore.

5.1.1.3 Other fishing threats

Other fishing threats to Hector's and Maui's dolphins that have been identified include cray potting and drift netting.

Cray potting involves setting a baited trap on the seafloor. These traps (pots) are either made from nylon mesh; or are made from steel and wire. There have been three known incidents of Hector's dolphins becoming entangled in a rock lobster pot line.[85] All of these incidents have occurred in the Kaikoura region. There has been no incident of a Maui's dolphin becoming entangled in a rock lobster pot line. Given the level of cray potting activity that occurs off the WCNI this fishing activity is considered to pose a low level of risk to the Maui's dolphin population.

Drift netting is a form of set netting where nets are not anchored to land or the sea bed so they drift freely with the current. Drift nets float freely with the current and do not roll up like set nets commonly do, which poses a high level of risk to Hector's and Maui's dolphins because any net that drifts into the dolphins range may entangle them. There are current drift net prohibitions that exist in New Zealand waters including within Port Waikato.[86] As drift netting is a prohibited fishing activity any management measures to address the risk the activity poses to the Maui's dolphin population would need to be captured through compliance and education programmes.

5.1.1.4 Marine farming

Marine farms have the potential to affect Maui's dolphins in many ways, including:

- Habitat competition, displacement, and fragmentation
- Entanglement
- Noise disturbance from construction activities and increased boat traffic
- Debris ingestion
- Ecological effects on the food supply of dolphins

Aquaculture operations off the WCNI are comprised mainly of Greenshell™ mussel and Pacific oyster production within the Kaipara and Manukau Harbours. Given the level and location of the aquaculture activities occurring off the WCNI, they are considered to pose a low level of risk to the Maui's dolphin population.

Habitat competition and fragmentation

The effect of aquaculture on whales and dolphins is a relatively new field of study, and limited information is available at this stage. A key concern would be the potential impact of marine farms in areas of existing high use by Maui's dolphins and areas used for breeding, calving, nursing or other critical activities (for example, feeding grounds). There is potential

[85] One incident in: 1989; 1997; and in 2004. All three resulted in death of the dolphin involved.
[86] Driftnet Prohibition Act 1991 and Fisheries (Auckland and Kermadec Areas Commercial Fishing) Regulations 1986

for habitat fragmentation to occur in areas where there are continuous series of marine farms that modify a large stretch of coastline. This is particularly so for Maui's dolphins, because of their small home range.

Entanglement in aquaculture operations
Entanglement of marine mammals in aquaculture operations appears to be especially problematic for large whales, but mussel farms are generally considered to be low risk for dolphin entanglement.

Noise
An increase in underwater noise and human activity can be expected during construction, maintenance and harvesting of marine farms. The effects of this disturbance on marine mammals near shellfish farms are unstudied, and there is conflicting anecdotal evidence about noise avoidance behaviour of cetaceans as a result of industrial activities.

Vessel traffic
Vessel traffic associated with marine farms typically consists of slower vessels (8 – 13 km) that cannot change direction very quickly, and therefore there is a low risk of boat strike. The amount of vessel traffic associated with marine farms is a low proportion of total traffic, including in areas where the aquaculture industry is well developed.

Debris
Potentially harmful operational by-products of mussel farms include lost lines, farm support buoys, and plastics. Debris can build up on the seabed directly below mussel farms. While such problems should be minimal in properly maintained farms, the potential for material loss is very real after stormy weather and in poorly maintained farms. Generally, the only materials lost more often are small pieces of lashing (<100 mm) and intact floats without attached lashing.

Potential hazards associated with Maui's dolphins include entanglement and/or plastic ingestion. However, there is little information to indicate whether marine mammals in New Zealand are affected by debris from aquaculture.

Prey availability and foraging
Marine farm structures may also interfere with dolphins' sonar signals and communication, reducing the ability of dolphins to hunt successfully. Dolphins that hunt collaboratively for schooling fish (for example, dusky, common and Hector's and Maui's dolphins) may be adversely affected.

Alternatively, some fish species are known to aggregate around shallow water structures and thereby provide areas of higher fish abundance than in the open water. This can make good foraging areas for coastal dolphin species, and Hector's dolphins are sometimes known to feed around bivalve marine farms.

5.1.2 Non-fishing-related threats

5.1.2.1 Seismic surveying

Marine seismic survey investigations to determine sub-seabed geophysical formations are most frequently associated with oil and gas exploration activities. However, they are also employed in seabed minerals mining, in scientific research and for installation of submarine cables and pipelines.

Seismic surveying involves using high-intensity acoustic sources to generate underwater sound, which is directed in a narrow, focused beam towards the seafloor. Towed arrays of hydrophones detect energy reflected from deep within the sub-seafloor formations, to give a detailed picture of structures. Depending on application, the underwater sound generated can be significant, and there is potential for a range of direct (physical trauma; for example, internal organ damage, hearing loss, decompression illness) and indirect (non-trauma; for example, masking communication/navigation, prey avoidance, behavioural) negative impacts on marine mammals. Impacts can be particularly pronounced in shallow waters, where dissipation of sound energy may be limited.

Seismic survey activities are regulated within the existing West Coast North Island Marine Mammal Sanctuary. Outside this area, DOC established voluntary guidance in 2006 which was replaced by a Code of Conduct in August 2012. There is no evidence to suggest that the activity has ever been subject to any other regulatory control, such as might be possible under s16(1) of the Resource Management Act 1991.

Past seismic survey tracks in the region of interest can be found in Map 7 (Appendix 1).

5.1.2.2 Seabed minerals exploitation[87]

The primary seabed minerals interest in the relevant area of the WCNI is ironsand from seafloor sediments – which is a general term for sand-sized grains of heavy iron-rich minerals. The prospecting, exploration and mining phases of seabed minerals exploitation have a range of possible impacts increasing in potential magnitude with each successive stage, with similar potential for increasing associated recovery times. The extent and significance of effects will depend on a number of factors including:

- the sensitivity of habitats and species;
- the scale of activities;
- the method and rate of extraction, and;
- the nature of the benthic environment being disturbed.

Potential effects on Maui's dolphins as well as benthic environments and marine ecosystems include disturbance through presence and/or noise, displacement, increased risk of vessel strike or entanglement, sediment plume generation, mobilisation of naturally occurring contaminants (such as heavy metals), trophic effects (impacting prey species and fisheries), coastal habitat degradation due to changes in coastal processes and pollution from vessel discharges, offshore processing or harmful substance spills.

It should be noted that impacts could be compounded by the cumulative effects of multiple mining projects being undertaken simultaneously in the Maui's dolphin range.

Prospecting

Prospecting phases may involve seismic and magnetometer (towed or aerial) surveying, as well as acoustic swath mapping to determine bathymetry. In addition, physical sampling (taking cores, often with a sonic drill) is likely over relatively large areas to quantify ore concentrations at various depths within sediment layers. Cores are likely to be about 10-15 cm in diameter and affect a very small proportion of the sediment habitats in the area.

[87] Information on potential impacts sourced fromMacDiarmid et al (2011)

Exploration
Using the results of the prospecting phase to focus on areas showing promise, the exploration phase involves more intensive evaluation of potential mining sites at the order of 30-50 km^2 (within permit blocks of the order of 300-500 km^2) to identify sites capable of sustaining mining for a decade or more. Obtaining sediment cores and drill logs to better quantify ore concentrations at various depths is likely to continue during this phase but will probably be most concentrated over a small proportion (<1-5 percent) of the licence area. Small scale dredging (taking samples of approximately 5 m^3) by divers using hand-held suction systems may also occur.

Mining
No seabed minerals mining permits have been issued, but this would logically follow the exploration phase if results indicated that commercially viable quantities of minerals were present. During mining, extraction methods such as suction-cutter dredge technology or other standard dredging techniques will likely be used, removing or disturbing significant quantities of seabed sediment from a few metres to tens of metres deep depending on the three-dimensional distribution of the resource. The extent of area directly affected at any one time is likely to vary depending on the size of the mining permit area and method used for extraction. Under a mining permit the holder will seek to progressively mine the resource over the majority of the permit over the duration for the permit (20-40 years). For example an economic rate of iron sand extraction could disturb around 10-15 (or more) square kilometres of the sea floor a year.

Mining will likely involve sequential removal of sediments and backfilling of excavation pits with de-ored sediments, causing as much as 100% mortality to benthic organisms in the affected area and generation of significant sediment plumes. Coarse particles would be deposited quickly, but fine particles could travel significant distances of the order of 5-20% of the permitted area. Operational noise is likely to be significant.

Recovery times would vary according to the species concerned. Small benthic organisms may recover in months, whereas larger species (such as shellfish) could take years. While pelagic species are likely to return once activities cease, it is difficult to predict trophic effects that could continue to impact on mobile species for several years before prey species abundance and distribution return to normal. There is likely to be some change in species structure as a result of disturbance.

Mining permitting and consenting
New Zealand Petroleum and Minerals is responsible for issuing prospecting, exploration and mining Permits under the Crown Minerals Act 1991 (which is currently subject to legislative review), and the Continental Shelf Act 1964. Within 12 nautical miles environmental effects are managed primarily through the Resource Management Act 1991 ('RMA') by the relevant regional council. Depending on the nature of the regional coastal plan, activities that would be undertaken during prospecting and exploration phases such as core sampling would likely be considered a permitted activity, whereas any form of dredging would probably be discretionary. Beyond 12 nautical miles, minerals activities will be covered by the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012. Discretionary activities will require marine consent from the Environmental Protection Authority.

Locations of minerals permits in the region of interest can be found in Map 8 (Appendix 1), and further detailed information on permits and permit holders can be found on the

New Zealand Petroleum and Minerals website (www.nzpam.govt.nz) – though it should be noted that mining targets will likely only be a fraction of the total permitted area.

5.1.2.3 Commercial marine tourism

Tourist vessels interacting with marine mammals have the potential to impact on individuals or the population both directly and indirectly. Direct effects are mainly through vessel strike, but indirect effects may range from altering the animals' activity budgets (e.g. reduction in foraging or resting behaviour), masking of biologically important behaviours (increased noise levels interfering with communication and echolocation), to displacement from an area.[88]

Marine tourism – subject to DOC permit

Permit based tourism includes tourist ventures that hold a Department of Conservation Commercial Marine Mammal Tourism Permit, which allows the holder to specifically look for and view marine mammals according to their permit conditions. There are currently no permitted tour operators that specifically target Maui's dolphins within their range.

Marine tourism – not subject to DOC permit

Non-permit based tourism refers typically to tour operators offering some sort of scenic trip or charter fishing, where the viewing of marine mammals is not a planned activity as a part of the trip, therefore they do not hold a Commercial Marine Mammal Tourism permit. These vessels should not be actively seeking out marine mammals, but should they come across them opportunistically, as with recreational boating traffic, they must abide by the Marine Mammal Protection Regulations (1992) ('the MMPR'). Regulations 18-20 specifically prescribe safe boating behaviour around marine mammals. The exact level of unpermitted tourism that occurs in the Maui's range is difficult to determine and limited ability to undertake compliance is of concern. However, given the exposed characteristic of the coastline, unpermitted tourism is likely to be minimal in comparison with more sheltered areas.

5.1.2.4 Vessel traffic

Other general vessel traffic has the ability to impact Maui's dolphins in much the same way as marine tourism. From direct to indirect effects including; physical injury or death, noise, altering activity budgets, masking biologically important behaviours, to displacement from an area. This mostly includes recreational boats, but of particular relevance to Maui's dolphins are; Thundercat racing, and Surf Life Saving events which may take place within the dolphins range. These vessels may have limited visibility of dolphins when at high speed, and the noise levels from these vessels is likely to be higher than the smaller recreational boats.

5.1.2.5 Pollution

The near-shore habitat of Maui's dolphins exposes them to a variety of pollutants and contaminants such as organochlorines, heavy metals, oil spills and plastic debris, which may be derived from land or maritime activities. Stormwater discharges are known to be significant point-sources of such pollution, but there are also risks from discharges associated with shipping. See Map 9 (Appendix 1) for locations of point source discharges that may reflect areas of higher risk of pollution.

Organochlorines

Maui's dolphins have a high metabolic rate, have a relatively high trophic position in the food web (that is, they are top predators), and live in coastal inshore environments which increase their likelihood of accumulating toxins such as organochlorines[89]. The effects of the build up

[88] Bejder and Samuels (2003)
[89] Reijnders and Aguilar (2002)

of toxic chemicals in marine mammals can include immune suppression and the development of infectious diseases, reproductive impairment (for example, sterility in some cases), and the generation of tumours[90]. The toxins are also transferred between mother-calf pairs both through the placenta prior to birth as well as through lactation after birth[91]. Studies on Hector's and Maui's dolphins show high levels of organochlorines such as DDT, PCBs and dioxins[92]. It was difficult to make comparisons between Maui's dolphins and South Island Hector's populations due to the small sample size of Maui's available for the study, however, toxins tended to be considerably higher for the WCNI than for the WCSI, but less than the levels observed on the ECSI. The high levels observed in the various populations highlight the vulnerability of Maui's or Hector's dolphins to coastal human activities (for example, agriculture, industry etc)[93]. While no Maui's dolphins sampled have exhibited PCB levels over the concentration level considered to have immunological or reproductive effects, trace elements and other emerging contaminant levels have yet to be studied[94]. Due to the industry activities and various forms of coastal development along the west coast of the North Island, there is concern over the potential for increased levels of organochlorines in Maui's dolphins.

Metals

Non-essential metals (for example, mercury, lead and cadmium), which have little or no recorded biological function, can accumulate and are toxic even at low concentrations. However, some data exists for Hector's dolphins showing evidence of accumulation of high levels of cadmium, though low levels of lead[95]. Data on the effects of metal toxicity is sparse, and the risk for Maui's dolphins is not quantified. For other species there is evidence that high levels of non-essential metals may have resulted in or contributed to chronic illness and mortality of cetaceans[96].

While there is currently no information on the levels in Maui's dolphins, similar to other forms of pollution, the risk of pollution impacting on this population could increase in the future.

Oil spills

While cetaceans are presumed to be less vulnerable to oiling than many other marine species such as otters and seabirds, oil may damage the eyes, and inhalation of surface vapours can damage their lungs. Also, oil spills may have long-term impacts on prey populations such as fish and benthic invertebrates[97]. Understanding of the long-term impact of oil spills on cetaceans has grown following the Exxon Valdez oil spill in 1989[98]. Prior to the spill it was not clear whether cetaceans could detect and avoid oil, however, research suggests that while vision can help cetaceans to detect thick oil, they often rely on tactile response in order to avoid the oil, meaning that they will still come in contact with it and run the risk of ingestion or inhalation[99]. It has been suggested that the lack of an olfactory system for cetaceans may make it more difficult for these species to avoid oil than other species[100]. Little is known about the effects of oil spills on cetaceans in New Zealand, so information from overseas is vital. A study on the effects of the Exxon Valdez oil spill on Orca/Killer whales found that

90 Summarised in Stockin et al (2010)
91 Stockin et al (2007)
92 Stockin et al (2007); (2010)
93 O'Shea (1999)
94 Stockin et al (2010)
95 Slooten and Dawson (1994)
96 Beland et al (1993)
97 Hines (2011)
98 Matkin et al (2008)
99 Smultea and Wursig (1995)
100 Matkin et al (2008)

two groups of whales suffered losses of 33 and 41% in the year following the oil spill and that 16 years after the oil spill one group had still not recovered to pre-spill numbers[101]. This suggests that while the likelihood of a spill in New Zealand may not be high, the consequence of a spill on a small inshore population of cetaceans with a small home range could be catastrophic.

The grounding of the MV *Rena* off the Astrolabe Reef, off Tauranga in 2011 highlighted the potential impact of an oil spill on the New Zealand marine environment. It is important to note that it is not just the oil itself that may impact on the dolphins, but many aspects of an oil spill response will have direct or indirect effects on the population, eg, the use of dispersants to clean up the oil, increased vessel activity in the area, the use of sonar for tracking lost cargo etc. Prior to this, other significant oil spills from commercial vessels have been relatively infrequent events in New Zealand waters, though there has been six of note since 1990:

- 1998, *Don Wong 52*9 - Stewart Island (with 400 tonnes of automotive gas oil spilled)
- 1999, *Rotoma* - Poor Knights Island (oily bilge discharge of approx 7 tonnes spilled)
- 2000, *Sea Fresh* - Chatham Islands (60 tonnes of diesel spilled)
- 2002, *Jody F Millennium* – Gisborne (25 tonnes of fuel oil spilled)

Though significant oil spills from commercial vessels have not occurred within the Maui's dolphin range, there were have been a number of incidents involving the 74,000GRT iron sands carrier MV *Taharoa Express* which routinely operates in the vicinity of Kawhia Harbour. The *Taharoa Express* has now been replaced by a purpose built vessel, the *Taharoa Destiny* in order to address safety issues experienced during previous operations. While risks have been reduced significantly, regular and ongoing operations of a large vessel within the Maui's dolphin range have inherent associated risks. However, these can be minimised through effective management practices.

All of New Zealand's offshore oil and gas production currently occurs in the Taranaki Region. There have been two significant spills, both associated with Floating Production, Storage and Offload (FPSO) facilities - the Tui field FPSO *Umuroa* estimated spill of 20-25 tonnes in 2007, and the Maari field FPSO *Raroa* estimated spill of 1 tonne of oil in 2010. In both instances the spills resulted in shoreline impacts, on the south Taranaki and Kapiti coasts respectively. Most of the Taranaki fields are currently producing gas condensate, which though volatile and relatively quick to evaporate through weathering processes, contains liquid fractions that could remain on the water surface and impact shorelines. Naturally occurring reservoir pressure in the Taranaki fields is variable, some being insufficient to flow oil in significant quantities should a production well lose integrity, some requiring additional pressurisation support, and others which would free flow. In addition, there are specific risks associated with FPSO operations such as offshore storage and offloading of oil to shuttle tankers, though these are minimised through appropriate operational procedures derived from international best practice.

Modelling of a major, continuous spill from the Tui or Maari installations illustrates that oil could potentially affect all of the North Island's West Coast (see Map 10 in Appendix 1), which is a broadly similar scenario to the other fields. However, continued release spills are rare, and geographical spread of single release spills is much more limited in extent. According to the oil spill risk modelling there is a slightly higher risk around the Taranaki coastline based on future oil exploration activities. Drilling activity is predicted to be limited in the next 12 months with only one new well scheduled in the offshore Taranaki region, with proposals to drill a further 10 wells in and around the Maui's range over the next 4 years.

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[101] Matkin et al (2008)

Harmful substance spills

Risks associated with spills are not limited to oil products, but may involve other harmful substances carried as cargo or used in maritime activities such as offshore drilling. While marine oil spill impacts can be severe, for the most part the material remains on the water surface where tried and tested response options are at least possible. This is not necessarily the case with other harmful substances such as chemicals, which may mix readily with water and quickly enter the water column. In these instances, response options are extremely limited and there may be no possibility of avoiding widespread effects other than relying on natural dilution processes. Even a product as seemingly innocuous as milk powder can have significant impacts due to oxygen depletion, which can be particularly pronounced in confined areas with limited tidal exchange such as inlets and harbours. In such instances,

while direct effects on Maui's dolphins are unlikely, indirect effects on prey species could be significant in specific areas.

The probability of oil or other harmful substance spills from maritime activities remains small, though consequences could be devastating to the Maui's dolphin population in a worst case scenario.

Locations of exploration and mining permits can be found in Map 8, and a summary of risks associated with oil spills around the New Zealand coast can be found in Map 10 (Appendix 1)[102].

Operational discharges

During normal operations of vessels and offshore installations, certain low-levels of discharges (oil, chemicals, sewage, garbage etc) are permitted providing strict criteria are met according to the location where the discharge occurs (either within or beyond 12 nautical miles). Regulations will either be administered by the relevant regional council under the Resource Management (Marine Pollution) Regulations 1998 or by Maritime New Zealand through a range of Marine Protection Rules. In most normal operating circumstances the risk of impacts from discharges is considered to be low as the strict limits that apply would minimise harmful effects. However, faulty equipment, deliberate acts, or the presence of pathogens in sewage from humans or livestock carried on board commercial vessels have the potential to pose significant risks.

Plastic debris

Plastic debris constitutes a potential threat to marine mammals as they can become physically entangled in floating debris or ingest the debris[103]. If not removed the debris can cause drowning, suffocation, strangulation, starvation and injuries or infections and it can also impair important behaviour such as foraging and predator avoidance through increased drag[104]. Ingestion of plastic can cause a range of problems that have the potential of being fatal including stomach ruptures, digestive problems, and starvation[105]. It is difficult to quantify the impact of ingestion of plastics on marine mammals, and there is no current evidence for Maui's dolphins. Additionally as the most common entanglement material for whales and dolphins is fishing gear it is usually difficult to determine if the entanglement is from active fishing gear or lost or discarded gear.[106]

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[102] Derived from Maritime New Zealand's 2010 Oil Spill Risk Assessment. The sensitivities identified in the map relate primarily to oil spills. However, there is some cross-over with harmful substances, as in some cases the ecological sensitivities will be the same.
[103] Simmonds (2012)
[104] Ceccarelli (2009)
[105] Jacobsen et al (2010)
[106] Simmonds (2012)

The potential risk of entanglement from poor fishing practices is addressed in Section 6 (MPI chapter)) of this document.

Pathogens
As a coastal species, Maui's dolphins may be exposed to a range of pathogens that end up in the sea from farm run-off, through sewer outfalls or shipping, as well as through direct or indirect contact with other marine species. While there may be an anthropogenic source for some pathogens, the exact origin of Toxoplasmosis and Brucella is not confirmed. Therefore, these are discussed in the later Section 5.2.1 on parasites and disease.

5.1.2.6 Coastal development

Land-use
Land-based activities such as forest clearance, sub-division and agriculture within catchments draining towards the Maui's dolphin habitat have primarily indirect impacts on the population through terrestrial run-off processes. Sedimentation (both in suspension and deposition) and changes in nutrient flows, in addition to pollution inputs noted earlier, may cause ecological consequences at differing trophic levels, impacting on the diversity and abundance of prey species. Therefore, land management practices are an important consideration in mitigating threats to Maui's dolphins. Morrison et al (2009)[107] provides a useful summary of potential impacts on coastal fisheries, which is of direct ecological relevance to predators such as Maui's dolphin.

Significant point and non-point source discharges within the historic Maui's dolphin range can be seen in Map 9 (and coastal activities are summarised in Map 11 in Appendix 1).

Marine Construction
Construction in the Coastal Marine Area, associated with such installations as wharves, jetties, breakwaters etc, may involve disturbance through presence, habitat fragmentation, sediment resuspension, vessel strike, pile-driving and other sources of noise.

Aside from very small-scale construction projects with limited, localised impacts, no significant developments have been identified in the Maui's dolphin historic range that would cause particular concerns.

Dredging and dredge spoil disposal
Dredging is necessary to maintain navigable waterways, and is primarily associated with commercial ports. Most dredged material is transported to marine dump sites and disposed of in the Coastal Marine Area in accordance with Coastal Permits issued by the relevant regional council under the Resource Management Act 1991 ('the RMA'). Effects may include sedimentation and resuspension of contaminants, which accumulate from industrial and maritime activities in port environments.

There are two main ports on the west coast of the North Island - Onehunga (in the Manukau Harbour) and Taranaki.

Port of Onehunga requires regular dredging of relatively small volumes of sediment (5000-10,000 m^3 annually) which is disposed of in a reclamation project at another Ports of Auckland facility, the Fergusson Container Terminal reclamation on the Waitemata Harbour (Auckland's east coast).

Port Taranaki currently holds two consents for spoil disposal in relation to their maintenance

[107] Morrison et al (2009)

dredging activities. One allows up to 400,000 m^3 in any one dredging campaign, and up to 730,000 m^3 for any three successive dredging campaigns (or any seven year period – whichever comes first), to be disposed of within inshore disposal areas. The second consent allows up to 2,000,000 m^3 to be disposed of within an offshore disposal area. Clean sediments, primarily sand, can be disposed within inshore areas for the purposes of beach renourishment as the main port breakwater interrupts the northerly littoral drift pattern, while the offshore is for surplus or contaminated material. Maintenance dredging in Port Taranaki is usually undertaken every two years, and currently involves disposal of around 100,000 m^3. Accumulated sediments are comprised mainly of clean sand being brought into the port from the surrounding coastline by long-shore drift and tidal movement. Marine disposal of sand does not have the same level of risk of plume generation as finer sediments, and general absence of contamination reduces risks even further.

Wave and Tidal Energy

Marine renewable energy remains largely at the research and development/pre-commercial level, with a wide range of device designs being trialled in various places around the world.

Deployment of marine renewable energy devices is in early stages internationally, and the level of understanding about actual impacts on marine mammals is limited as a result. Potential impacts will vary between construction and operational phases, which include disturbance through presence and/or noise, displacement, and risk of vessel strike.

It is considered unlikely that dolphins would be physically injured through collision with an underwater turbine blade given the slow operational speeds of equipment (around 5 rpm). One of the few examples of long-term commercial scale marine energy deployment worldwide is the Seagen tidal generator that was installed in Strangford Loch in Northern Ireland in 2008. The project was consented on the basis of adaptive management, with an agreed Environmental Monitoring Programme that included specific monitoring for marine mammals through visual observation (66 months), passive acoustic monitoring (54 months) and trials of active sonar over a 4 year post-installation period. Results indicated that there have been no major impacts detected from the monitoring programmes, and no changes in abundance of either seals or porpoises[108].

Within the Maui's dolphin range Crest Energy has gained resource consent for staged deployment of up to 200 tidal energy devices in the mouth of the Kaipara Harbour. Progression through each stage can only be achieved in accordance with an agreed Environmental Monitoring Plan, providing that effects are within predicted ranges. Monitoring data will be evaluated by the consent authority (Northland Regional Council) under section 128 of the RMA, before the start of each stage of the project. Monitoring will also occur continuously during operation of the power station.

Two years of baseline data will be collected prior to the Stage 1 deployment, with monitoring continuing during Stage 1 and for a minimum of 12 months after completion of Stage 1 prior to initiation of Stage 2. A similar process will apply for the transition between later stages. The stages are for 3, 20, 40, 80 and 200 turbines.

5.1.2.7. Scientific interactions

Marine mammal research can utilise non-invasive or invasive or methods. Non-invasive methods can pose a threat to Maui's dolphins through harassment and boat strike in the same

[108] Alistair Davison, Royal Haskoning UK, pers. comm.

manner that marine tourism may adversely affect the dolphins (see Sections 5.1.2.3 and 5.1.2.4). Non-invasive research methods do not require a DOC marine mammal research permit granted under the Marine Mammals Protection Act, but are subject to the MMPR regulations 18-20. Regulations 18-20 dictate appropriate behaviour around marine mammals. It is important to note that the impacts from non-invasive research, while similar to commercial tourism or recreational boat traffic, are likely to be reduced given the experience of the researchers in operating safely around marine mammals.

Invasive methods, however, could potentially pose a threat to Maui's dolphins through complications arising from the techniques such as tagging (including satellite or other transmitters) and taking biopsy samples. These are considered under the MMPA as "take" and therefore require a application for a permit under the MMPA to undertake the work. As a part of the requirements for the permit application Animal Ethics Committee approval is required. There is a DOC Standard operating procedure which provides guidance on approval of permits. As a part of the process permits may be subject to conditions developed to ensure risks to the safety or wellbeing of the dolphins are mitigated. Impacts of scientific interaction on Maui's dolphins are likely to be minimal due to strict permitting and animal ethics approval requirements as outlined in section here.

5.1.2.8 Shooting

Although there have been historical reports of dolphins being shot, there are no known recent incidents.

5.1.2.9 Climate change

Trying to anticipate future effects of climate change on the Maui's dolphin population is difficult as predictions are largely speculative. The interactions between ocean processes and climate are complex and effects may vary greatly between areas. However, a number of possible negative future effects of climate change on marine mammals have been highlighted[109], the greatest of which probably arises from changes in food source. Those species with a limited habitat range, such as Maui's dolphins, may be especially vulnerable to changes in prey distribution and abundance.

Impacts of climate change can be direct or indirect. Direct effects could include the a shift in species' distribution if temperature is a limiting factor, however at present there is no direct evidence this could be the case for Maui's dolphins. Indirect effects of changes in temperature include prey availability affecting the distribution, abundance, community structure, susceptibility to disease and contaminants (due to immuno suppression and mobilisation of contaminants from blubber reserves), reproductive success, and ultimately, survival of marine mammal species.

Rising sea levels may degrade the coastal habitat as could construction of structures to protect coastal areas from sea level changes. Changes in rainfall patterns and increased nutrient run-off, as well as changes in temperature, salinity, pH and CO_2 could potentially increase the scale in incidence of toxic algal blooms and the input of terrestrially derived pathogens into coastal areas. Changes in ocean currents, upwellings and fronts may result in changes to the distribution and occurrence of prey associated with these environmental changes.

Storm frequency, wind speed and wave conditions are predicted to intensify with climate change and severe weather events may pose a physical threat to dolphins. There may also be increased energetic costs to dolphins from responding to increases in disturbance that may

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[109] Simmonds and Isaac (2007); Robinson et al (2005)

affect foraging and reproduction. In conjunction with rising sea levels, such weather events may exacerbate damage to coastal ecosystems, further degrading Maui's dolphin habitat.

5.2 NON-HUMAN INDUCED THREATS TO MAUI'S DOLPHINS

Non-human-induced threats include those naturally occurring causes of mortality that any population is subject to, such as disease, predation, extreme weather events and small population effects. The intrinsic rate of population increase accounts for these natural sources of mortality. This means that a population that is still growing and is not subject to human-induced mortality can feasibly continue to grow at its maximum rate even with natural mortality. Natural mortality only becomes an issue when human-induced mortality results in the population being more susceptible to natural mortality. An example of this would be if as a result of human-induced mortality a population was displaced to an area where the risk of predation is increased. The following section outlines what is known about the key sources of non-human induced mortality to Maui's dolphins.

5.2.1 Disease[110]

Different types of disease can impact on a population. There are natural diseases, diseases that are transferred from other species or land-based run-off, and stress induced disease. While the later two may be anthropogenic in origin there is minimal evidence to confirm the origin of diseases such as *Brucella* and Toxoplasmosis. As such they are discussed in this section; however, DOC and MPI note that effort is needed to determine the origin of such diseases and if able to be controlled or minimised, appropriate steps are taken (see Section 8.1.1 on research priorities).

5.2.1.1 Brucella

An assessment of the health of Hector's dolphins during a trial tagging study at Banks Peninsula found that most results were within expected ranges or not significantly different compared with similar species. One of the tagged animals tested positive for the antibodies to *Brucella abortus* (or a similar organism). *Brucella* is a pathogen of terrestrial mammals that can cause late pregnancy abortion, and has been seen in a range of cetacean species elsewhere. In 2006 *Brucella* was identified in a dead Maui's dolphin and this could have serious ramifications for this critically small population. Marine strains of *Brucella* may be transmitted horizontally (transmitted between peers) and vertically (transmitted from mother to foetus). Findings so far show that Hector's and Maui's dolphins have been exposed to the *Brucella* bacteria, although the actual importance of disease due to this agent is unclear at present.

5.2.1.2 Toxoplasmosis

Toxoplasmosis is a parasitic disease that spreads through ingestion of infected meat, ingestion of material contaminated by faeces from cat, or by transmission from mother to foetus. Toxoplasmosis can cause death, behavioural changes, still births, and reduced reproductive rate. The main source of infection for dolphins is likely to be through freshwater run-off from surfaces contaminated by cat faeces. It is unknown what the role of fish play in the potential infection pathway, but it is known that Toxoplasma oocysts can survive for months in water.

From the Department of Conservation Hector's and Maui's dolphin incident database and necropsy work from Massey University, 5 of 23 Hector's dolphins, and 2 of 3 Maui's dolphins had fatal toxoplasmosis (for example, this was the primary cause of death).

[110] Roe, W. Massey University, personal communication, 18 August 2012.

Further testing showed that of dolphins that died of other causes, 61% were also infected with Toxoplasma[111].

5.2.1.3 Other disease

Bacterial and fungal pneumonia have also been noted in several Hector's dolphins, and may have played a role in the deaths of some animals. This may be indicative of other intense, but sub-lethal, stress on the dolphins that lead to pneumonia or could be related to genetic factors causing decreased immune function.

Whale lice are found on freshly dead dolphins and at close range they can be seen living on dolphins as small dark brown spots, but do not appear to cause any harm. Several species of gastrointestinal nematodes, lungworms and flukes have also been found in Hector's dolphins. There is no evidence that these parasitic infections alone could have caused death.

5.2.2 Predation

Sharks are thought to be the main predators of Hector's and Maui's dolphins. Shark species known to consume these dolphins are great white, blue and broad-nosed seven-gilled sharks. Orca, mako sharks and bronze whaler sharks may also predate Hector's and Maui's dolphins, but there are no known instances of this occurring.

There are two reported instances of white sharks eating Hector's or Maui's dolphins off the North Island's west coast, , including an instance in the waters off New Plymouth in 2005 where are white pointer was caught incidentally and a Hector's or Maui's dolphin was found in its stomach[112]. Hector's dolphin remains have been found in the gut contents of seven-gilled sharks and blue sharks. A seven-gilled shark caught in the Manukau harbour was found to have Hector's or Maui's dolphin remains within its stomach.

5.2.3 Weather

Pathological reports of dead Hector's dolphins suggest extreme weather events have been a possible reason for the separation of stranded calves from mothers[113]. As discussed in Section 5.1.2.10, increases in the frequency of extreme weather events are predicted due to climate change, which have the potential to adversely affect Maui's dolphins.

5.2.4 Small population effects[114]

Given the size of the Maui's dolphin population it is vulnerable to small population effects such as stochastic and Allee effects. Stochastic effects refer to the inherent variability in the survival and reproductive success of individuals, which can result in fluctuating population trends for small populations. Therefore, small populations with very low growth rates are much more sensitive to random variations in survival and reproduction, and random environmental changes.

Stochastic effects are different from Allee effects (or depensation effects) that small populations may also experience if the survival or reproduction of individuals is compromised when they are at low abundance and therefore low densities.

Small populations may also suffer from reductions in genetic variability, also referred to as inbreeding depression. Loss of genetic diversity increases sensitivity to environmental change, and can also lead to increased extinction risk.

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[111] Roe, W. Massey University, Unpublished Data, August 2012.
[112] Duffy and Williams (2001).
[113] DOC 2012: Hector's and Maui's dolphin incident database. www.doc.govt.nz/dolphinincidents
[114] For more discussion on stochastic and Allee effects see also: Currey *et al*. (2012), or Stephens and Sutherland (1999).